NCDC
NATIONAL CURRICULUM DEVELOPMENT CENTRE

SELF-STUDY LEARNING

SENIOR 6

BIOLOGY

August 2020

THE REPUBLIC OF UGANDA

Ministry of Education and Sports

Topic: Homeostasis

Lesson 1

Sub-topic: Regulation of Glucose

By the end of this lesson, you should be able to explain the negative feedback mechanism in the process of blood glucose control.

Some useful reference: The Internet; a Functional Approach by Roberts pages 200-205; Biological science by Taylor *et al* pages 648-650.

General Principle of Homeostatic Control Process

Organisms can only function normally if their internal environments/conditions are kept within a specific range by a process called homeostasis. Homeostasis relies on automatic control systems of nervous responses (nervous system) and/or chemical responses (endocrine system) using specific receptors and effectors to restore internal environment/conditions (e.g. blood glucose level, body temperature, pH of tissue fluid, oxygen and carbon dioxide levels, osmotic pressure and ions) to set point/norm/specific range/desired range/reference point.

When there is a deviation from the norm, the receptors detect the change/stimulus and send impulses to the regulator. The regulator then sends impulses to the effector, the effector responds by making appropriate adjustment that return the internal environment to normal.

Regulation of Blood Glucose in the Mammalian Body

Activity 1: The need to regulate blood glucose in human beings

In this activity, you will perform tasks to illustrate the need for regulating blood glucose in human beings.

Task: Stand on one leg and hold your notebook in one hand. Stretch the hand with the notebook parallel to the ground surface for about 10 seconds. Then resume normal posture and settle for the next task. Outline all events that required energy during the task.

The energy that was used during those events was derived from glucose in blood which is a major respiratory substrate in the body. Hence, its amount in the blood must be regulated within a desired range/norm/set point/reference point to ensure continuous supply of energy to drive all life processes.

Blood glucose level in the body is largely regulated by insulin and glucagon hormones secreted by the pancreas. Each of these hormones when secreted reverses the level of glucose to a required correct norm.

Activity 2: How to maintain the level of blood glucose within the normal range

In this activity, you are required to explain how a healthy person maintains the level of blood glucose within the normal range by filing in the blank spaces with the correct words/set of words. (Use online resources or biology textbooks for reference)

When a person skips a meal, excess glucose is removed from the ---------- lowering the blood glucose level (hypoglycaemia). This stimulates the alpha cells in the ---------- of the pancreas to release glucagon hormone. It also stimulates the adrenal medulla of ---------- glands to release adrenaline hormone and the hypothalamus to instruct pituitary glands to cause the release of thyroxine hormone from the ----------.

These hormones are released into the ---------- and transported to the---------- and ---------- cells to release ---------- that is broken down in the ---------- to release more glucose to the blood. This raises the blood glucose level back to the ---------- and the stimulus for ---------- hormone reduces.

After a meal rich in carbohydrates, the concentration of ---------- rises above the norm (hyperglycaemia). This stimulates the ---------- cells of the pancreas to release the hormone ---------- into the blood. The hormone causes the body cells to ---------- and the liver cells to convert --------- to ---------- and ----------for storage, and also prevent synthesis of glucose from----------. The blood glucose level ---------- to a set point and the ---------- for insulin hormone release diminishes.

In conclusion, homeostatic regulation of glucose is important because when cells are deprived of enough glucose to carry out respiration, metabolic reactions may not be able to take place and the cells cannot function normally. For example, brain cells, which can only use glucose and no other respiratory substrates, will fail to function normally. This may lead to unconsciousness and damage of various tissues.

Also, high glucose levels above norm decreases the ability of the blood and tissue fluid to retain water, and so water moves out of cells by osmosis. This can also result into unconsciousness.

Lesson 2

Sub-topic: Regulation of Respiratory Gases

By the end of this lesson, you should be able to explain the role of respiratory and cardiovascular centres in the brain in controlling respiration and blood circulation.

Some useful reference: the Internet; A Functional Approach by Roberts pages 243-247; Biological Science by Taylor *et al* pages 288-290.

Regulation of Respiratory Gases in Man

Ventilation or breathing, is controlled by the sympathetic and parasympathetic parts of autonomic nervous system. Changes in the level of carbon dioxide in blood is detected by **any or all** of the chemoreceptors found in the carotid bodies, aortic body, cardiovascular centre and respiratory centre. Increased *rate and depth of breathing* (ventilation rate) and increased *rate and force of the heart-beat* (cardiac output) are all aimed at removing accumulated carbon dioxide in the body.

- Rate of breathing refers to the number of breathing in and out in a specified time.
- Depth of breathing refers to the length of inhalation or exhalation.
- Rate of heart beat refers to the number of times the heart pumps blood out in a given time.
- Force of heart beat refers to the strength with which the blood is pumped out of the heart.

Activity 1: The effect of rebreathing exhaled air on the ventilation rate

Let's perform simple tasks to demonstrate the effect of rebreathing exhaled air (increased carbon dioxide in the body) on the ventilation rate.

Step 1: In a calm and relaxed state, take note of the rate and depth of your breathing.

Step 2: Now cover your nose and mouth with a small clean black polythene bag and breathe repeatedly inside the bag for about **1** minute. Note the rate and depth of breathing.

Step 3: Remove the polythene bag and rest for **2** minutes and again note the rate and depth of breathing.

*Explain the significance of the difference in the rate and depth of breathing in steps **1, 2** and **3**.*

Activity 2: Exploring the role of the brain in regulating respiratory gases

Using the experience in the above steps, now let us explore the role of the brain in regulating respiratory gasesby filling in the spaces below with words/set of words so as to produce a correct write up about the regulation of respiratory gases in the body of a human being.

Carbon dioxide accumulation in the blood is more effective in stimulating ventilation rate and----------than increased concentration of ---------- gas at atmospheric pressure. High level/partial pressure of carbon dioxide in the body lowers the ---------- of blood which is detected by ---------- in the walls of ---------- and ---------- of aorta and carotid arteries respectively. These send impulses via ---------- nerves to the ---------- and ---------- centres in the medulla of the brain. The level of acidity of blood can also be detected by ---------- in the cardiovascular and respiratory centres. These centres send impulses via efferent nerves to three ---------- i.e. heart, thorax and arterioles. The heart responds by

increasing the ---------- and -------- of the heart-beat so that large volumes of blood containing high level of ---------- is rapidly transported to the ----------.

The thorax responds by increasing the ---------- and ---------- of breathing so that ---------- in the alveoli is ---------- out of the lungs. The arterioles respond by general ---------- so as to raise the blood pressure and locally increasing diameter of blood vessels supplying active respiring tissues so as to increase ---------- flow to those parts hence ---------- and this increases the pH of blood to norm/set point.

When the pH of blood is high/too alkaline, the breathing slows and ---------- builds up in the body so that the---------- drops to the set point.

In conclusion, breathing excess oxygen at *atmospheric pressure* is not dangerous and does not stimulate homeostatic adjustments. This is because the amount of oxygen delivered to the tissue remains the same. However, accumulation of carbon dioxide in the body is dangerous because it increases the acidity of blood and tissue fluids thereby inhibiting enzymes and stopping essential metabolic processes. This is why the deviation in the level of carbon dioxide in the body is a stimulus for homeostatic regulation of respiratory gases.

Lesson 3

Sub-topic: Temperature Regulation in Man

By the end of this lesson, you should be able to explain the role of the brain and thermos receptors in temperature regulation.

Some useful reference: The Internet, a functional approach by Roberts pages 236-237; Biological Science by Taylor *et al* pages 650 fig 19.4.

Temperature Regulation

The thermoregulatory centre of the hypothalamus controls nervous and hormonal responses that regulates body temperature. The thermoregulatory centre monitors the temperature of the blood **(core temperature/internal temperature).** The thermos receptors are in the skin and the hypothalamus itself. The hypothalamus function like a thermostat just like the one in an electric flat iron.

Activity 1: Let us demonstrate the functioning of the hypothalamus using an electric flat iron or charcoal iron box

a) **Using electric flat iron:** Plug the flat iron in the electric socket. Turn on the power and set the required temperature according to the nature of cloth/fabrics to be pressed/ironed. Begin to iron/press the cloth, note and explain the behaviour of the thermostat as indicated by the light on the flat iron.

b) Using charcoal iron box: Put red hot charcoal in the iron box, allow it heat up and begin to iron/press the cloth. Describe and explain how you will maintain the appropriate temperature during the ironing.

Note: All the activities that acted by reversing the amount of heat generated during the ironing acted like the thermostat of the hypothalamus in regulating the human body temperature.

Question

Outline the body's responses when the temperature of the surrounding is

i) cold
ii) hot

Activity 2:

Now using the illustrations and preceding information above, let us fill in the missing word/words so as to constitute an explanation of the correct role of hypothalamus in the temperature regulation in human beings.

When the temperature falls below the ----------, the cold receptors in the skin detect and send impulses to the ---------- in the brain.

Impulses are generated in the brain and sent to all ---------- responsible for heat ---------- and---------- in the body. The processes include:

vasoconstriction of arterioles carrying blood to the skin surface so as to ---------- loss to the surroundings,

---------- of erector-pili muscles so that hairs are upright trapping a layer of ---------- which is a ---------- conductor hence---------- the body against heat loss

The efferent nerves cause the reduction in the production of --------- from the sweat glands to minimize heat loss through ---------- of vaporization.

The release of adrenaline and thyroxine hormones from ---------- medulla and ---------- respectively cause an increase in the ---------- of skeletal muscles so as to ---------- more heat.

The two hormones cause increase in the rate of ---------- to generate more heat. All the above are involuntary activities.

The thermoregulatory centre also initiates voluntary activities such as ----------, ---------- etc. aimed at generating/conserving heat.

When the temperature rises above the ----------, the ----------directs the effectors to perform involuntary activities that facilitates heat ---------- from the body such as ----------

-------, ----------, ----------, ----------, ----------, ----------. It also initiates voluntary activities such as ----------, ----------, ----------,etc.

In conclusion, most physiological processes in the human body are controlled by enzymes. Enzymes are denatured by temperature above 40^{o}C and one of the first organs to be affected is the brain. Enzymes require optimum temperature for regulating important systems such as respiration, blood circulation and normal functioning of the entire organism. This is made possible by the body temperature self-regulatory mechanisms controlled by the thermoregulatory centre.

Lesson 5

Topic: Coordination

Sub-topic: Nervous Coordination in Animals

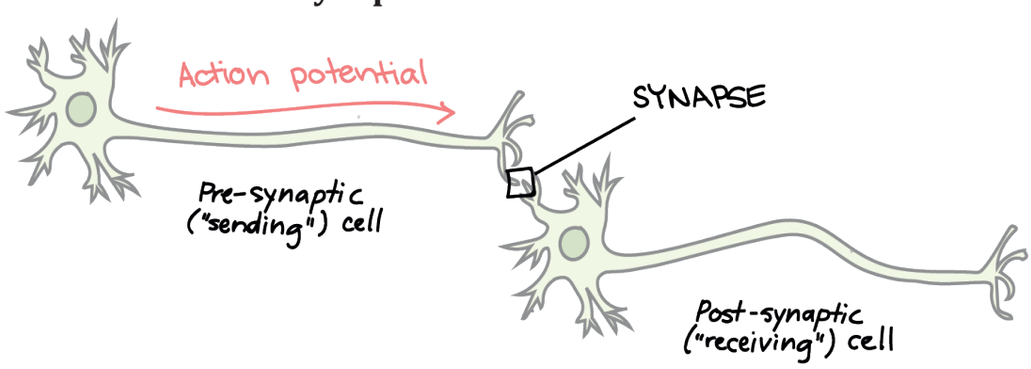
By the end of this lesson, you should be able to describe the structure and functioning of the synapse and neuromuscular junction.

Introduction

Individual neurons make connections to target neurons and stimulate or inhibit their activity. This forms circuits that can process incoming information and carry out a response.

How do neurons "talk" to one another? The action happens at the **synapse**, the point of communication between two neurons or between a neuron and a target cell, like a muscle or a gland. Synapses are usually formed between nerve terminals on the sending neuron and the cell body or dendrites of the receiving neuron.

Neuron to Neuron Synapse



The neuron before the synaptic cleft is called the presynaptic neuron or sending neuron while the neuron after the synaptic cleft is called a postsynaptic neuron or receiving neuron. The spot of close connection between axon and dendrite is the synapse.

The synaptic transmission can be either electrical or chemical in some cases, both at the same synapse!

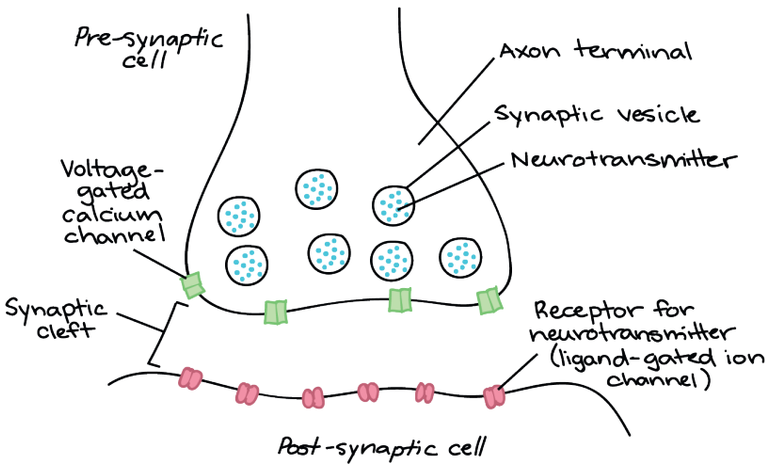
Chemical transmission is more common than electrical transmission. So, let us take a look at chemical transmission. You may make personal reading about electrical transmission.

Transmission at Chemical Synapses

Chemical transmission involves release of chemical messengers known as **Transmitter substances or neuro transmitters** such as dopamine, serotonin, acetylcholine, histamine, noradrenaline, etc. Neurotransmitters carry information across the synaptic cleft from the pre-synaptic neuron to the post-synaptic neuron/cell.

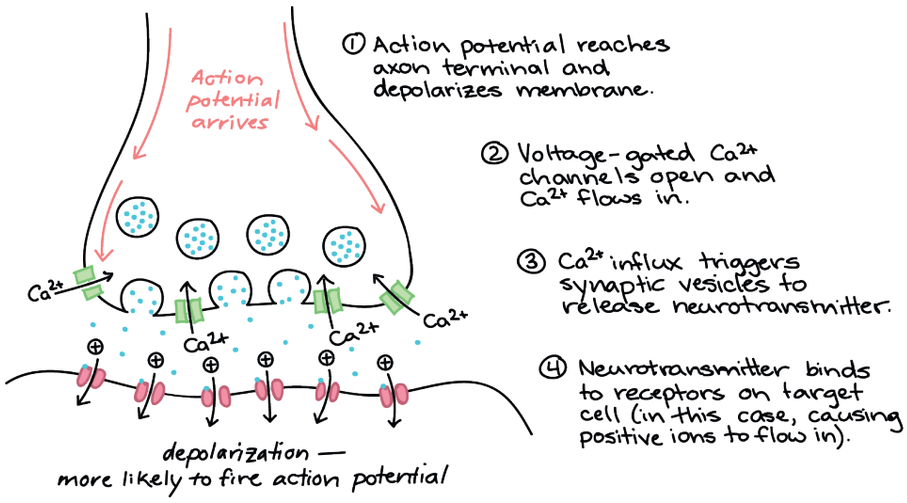
Structure of a Synapse

Inside the axon terminal (knob) of a sending cell are many **synaptic vesicles**. These are membrane-bound spheres filled with neurotransmitter substance molecules. There is a small gap between the axon terminal of the presynaptic neuron and the membrane of the postsynaptic cell, and this gap is called the **synaptic cleft**.



Transmission Across the Synapse

When an action potential, or nerve impulse, arrives at the axon terminal, it activates voltage-gated calcium channels in the cell membrane. Calcium ion which is present at a much higher concentration at the synaptic cleft than inside, rushes into the presynaptic neuron. The calcium ions activate synaptic vesicles to fuse with the axon terminal membrane, releasing neurotransmitter into the synaptic cleft.



Activity: Describe how an action potential is generated in a post synaptic neuron from action potential in a presynaptic axon terminal.

The molecules of neurotransmitter diffuse across the synaptic cleft and bind to receptor proteins on the postsynaptic cell. Activation of postsynaptic receptors leads to the opening or closing of ion channels in the cell membrane. This may be **depolarizing**—make the inside of the cell more positive—or **hyperpolarizing**—make the inside of the cell more negative—depending on the ions involved.

Lesson 6

By the end of this lesson, you should be able to explain the generation of excitatory and inhibitory post synaptic potentials, and signal termination.

Excitatory and Inhibitory Postsynaptic Potentials

Activity:

i) Blow through the valve of a bicycle tube or ball to have it inflated.
ii) Deflate the bicycle tube or ball.
iii) Cover the valve with a clean polythene paper and blow again.

Questions

1. Which structure acted as a synapse?
2. What activity permitted the passage of pressure and which one did not?
3. Explain how one specific structure ensures unidirectionality of communication.

Similarly, the synapse can either allow transmission of impulse across it or not. When a neurotransmitter binds to its receptor on a receiving cell, it causes ion channels to open or

close. This can produce a localised change in the membrane potential voltage across the membrane of the receiving cell. One of the following may occur:

i) The change makes the target cell or receiving neuron *more* likely to fire its own action potential. In this case, the shift in membrane potential is called an **excitatory postsynaptic potential**, or **EPSP**.
ii) The change makes the target cell or receiving cell *less* likely to fire an action potential and is called an **inhibitory post-synaptic potential**, or **IPSP**.

An EPSP is depolarising: it makes the inside of the cell more positive, bringing the membrane potential closer to its threshold for firing an action potential. Sometimes, a single EPSP isn't large enough to bring the neuron to threshold, but it can sum together with other EPSPs to trigger an action potential.

IPSPs have the opposite effect. That is, they tend to keep the membrane potential of the postsynaptic neuron below threshold for firing an action potential. IPSPs are important because they can counteract, or cancel out, the excitatory effect of EPSPs.

Spatial and Temporal Summation

Activity

Step 1

i) Obtain a piece of timber or wood, three iron nails, hammer or piece of rock.
ii) Hit a nail with a hammer or stone on the wood once (note the depth of penetration). Hit the second time and again note the depth of penetration.
iii) Hit the two other nails at once on the piece of wood. Note the strength used.

Question

Which activity summed the effect of hitting the nail by time and by space?

In the same way, the transmission of impulses across the synapse are summated to reach a threshold value.

How do EPSPs and IPSPs interact? Basically, a postsynaptic neuron adds together, or integrates, all of the excitatory and inhibitory inputs it receives and "decides" whether to fire an action potential.

- The integration of postsynaptic potentials that occur in different locations—but at about the same time—is known as **spatial summation** i.e. by space.
- The integration of postsynaptic potentials that occur in the same place—but at slightly different times—is called **temporal summation** i.e. by time.

For instance, let us suppose that excitatory synapses are made on two different dendrites of the same postsynaptic neuron, as shown below. Neither synapse can produce an EPSP quite large enough to bring the membrane potential to threshold at the axon hillock—the place where the action potential is triggered, boxed below. If both sub-threshold EPSPs occurred at the same time, however, they could sum, or add up, to bring the membrane potential to threshold.

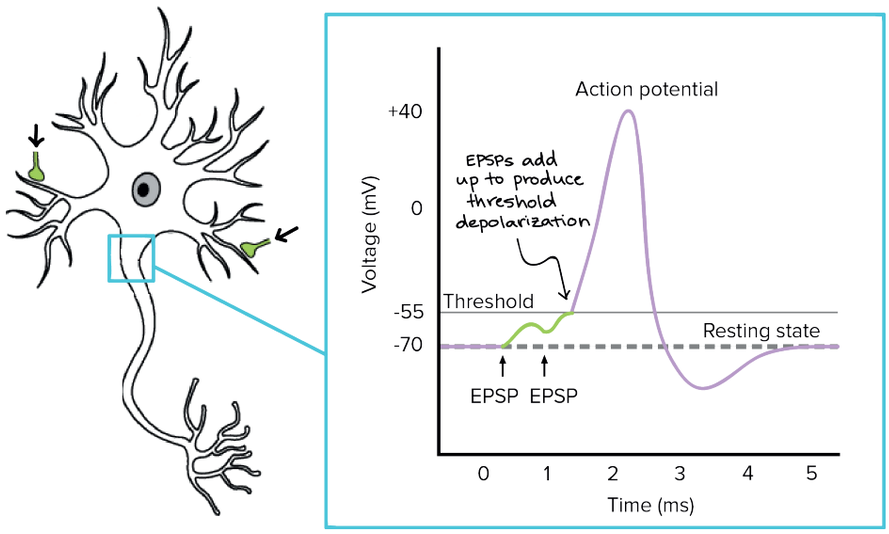


Illustration of spatial summation

A neuron has two synapses onto two different dendrites, both of which are excitatory. Neither synapse produces a large enough excitatory postsynaptic potential, EPSP, when it signals to generate an action potential at the hillock— the place where the axon joins the cell body and where the action potential is initiated. However, when the synapses fire at nearly the same time, the EPSPs add up to produce an above-threshold depolarisation, triggering an action potential.

This process is shown on a graph of voltage in millivolts vs. time in milliseconds. The graph monitors the membrane potential—voltage—at the axon hillock. Initially, it is at –70 mV, the resting potential. Then, one synapse fires, resulting in a small depolarisation to roughly –60 mV. This is not sufficient to reach the threshold of –55 mV. However, just a tiny bit later, the other synapse fires, and it "adds on" to the first depolarisation, resulting in a total depolarisation that reaches –55 mV and triggers an action potential—depolarisation to +40 mV, followed by a repolarisation and hyperpolarisation below –90 mV, and then a gradual recovery to –70 mV, the resting membrane potential.

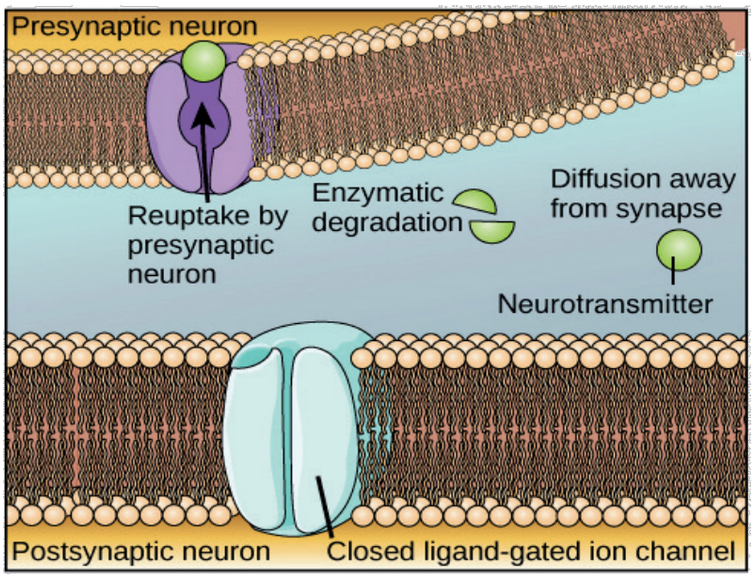
On the other hand, if an IPSP occurred together with the two EPSPs, it might prevent the membrane potential from reaching threshold and keep the neuron from firing an action potential. These are examples of spatial summation.

What about temporal summation? A key point is that postsynaptic potentials aren't instantaneous: instead, they last for a little while before they dissipate. If a presynaptic neuron fires quickly twice in a row, causing two EPSPs, the second EPSP may arrive before the first one has dissipated, bumping the membrane potential above threshold. This is an example of temporal summation.

Signal Termination

A synapse can only function effectively if there is some way to "turn off" the signal once it has been sent. Termination of the signal lets the postsynaptic cell return to its normal resting potential, ready for new signals to arrive.

For the signal to end, the synaptic cleft must be cleared of neurotransmitter. There are a few different ways to get this done. The neurotransmitter may be broken down by an enzyme, it may be sucked back up into the presynaptic neuron, or it may simply diffuse away. In some cases, neurotransmitter can also be "mopped up" by nearby glial cells.



Reuptake by the presynaptic neuron, enzymatic degradation, and diffusion away from the synapse reduce neurotransmitter levels, terminating the signal.

Anything that interferes with the processes that terminate the synaptic signal can have significant physiological effects. For instance, some insecticides kill insects by inhibiting an enzyme that breaks down the neurotransmitter acetylcholine. On a more positive note, drugs that interfere with reuptake of the neurotransmitter serotonin in the human brain are used as antidepressants.

Chemical Synapses are Flexible

You may remember that the action potential is an all-or-none response. That is, it either happens at its full strength, or it doesn't happen at all.

Synaptic signalling, on the other hand, is much more flexible. For instance, a sending neuron can "dial up" or "dial down" the amount of neurotransmitter it releases in response to the arrival of an action potential. Similarly, a receiving cell can alter the number of receptors it puts on its membrane and how readily it responds to activation of those receptors. These changes can strengthen or weaken communication at a particular synapse.

Presynaptic and postsynaptic cells can dynamically change their signalling behaviour based on their internal state or the cues they receive from other cells. This capacity for change, makes the synapse a key site for altering neural circuit strength and plays a role in learning and memory.

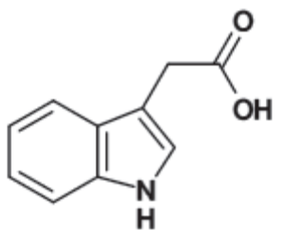
Lesson 7
Topic: Co-ordination
Sub-topic: Plant hormones

By the end of this lesson, you should be able to discuss the influence of hormones on plant growth and other related processes and the economic importance of these hormones

Introduction
All aspects of plant growth and development such are controlled by chemical substances called hormones. Plant hormones are signals produced within plants, that occur in extremely low concentrations

Influence of different hormones on plant growth
(a) Auxins

Auxins are any of a group of plant hormones that regulate or modify growth of plants, especially root formation, bud growth, and fruit and leaf drop. An example is indole acetic acid (IAA).



Indole-3-Acetic Acid
(an Auxin)

In the stem, a high concentration of auxins stimulates growth while high concentration of auxins in roots inhibits growth

What role do auxins play in plants?
Auxins stimulate cell elongation, cell division in the cambium, differentiation of phloem and xylem, root initiation on stem cuttings and lateral root development in tissue culture. They also mediate the tropic responses such as phototropism and geotropism; the auxin supply from the apical bud suppresses growth of lateral buds , delay leaf senescence and fruit ripening; they can inhibit or promote leaf and fruit abscission (via ethylene stimulation). They can induce fruit setting and growth in some plants. Auxins stimulate growth of flower parts; promotes femaleness in dioecious flowers through ethylene production; they also stimulates the production of ethylene at high concentrations.

(b) **Gibberellins**
This is another class of growth promoters produced particularly in young apical leaves, buds, seeds and root tips. They fall in group of chemical compounds called **terpenes.**

Role of gibberellins in plants
Promotes stem and root elongation thus, genetically dwarf varieties of peas and maize are restored to normal growth and dwarf beans can be converted into runners by application of gibberellins

Elongation of a dwarf plant due application of gibberellins

They also mobilize enzymes that release nutrient reserves in grass seeds; promotes growth of lateral buds; promotes development of seedless fruits (parthenocarpy); delays senescence; **stimulate** the growth of side branches from axillary buds; break dormancy and promotes germination of seeds promotes bolting and flowering in long day plants

Task 1: Basing on the roles of auxins and gibberellins discussed above, compare the effects of auxins and gibberellins in plants. How is this information useful to a farmer?

(c) **Cytokinins**
This is a class of growth substances that promote cell division. They do so, however in the presence of auxins. Gibberellins may also play a role, as in the cambium.

Roles of cytokinins
They Promote cell division, morphogenesis, stomata opening and development of lateral roots They also delay senescence

d) Ethylene (ethene)

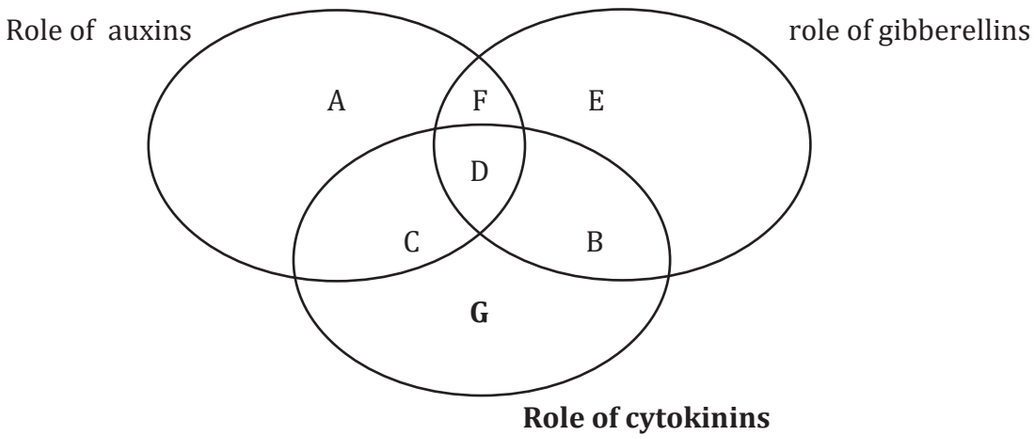
it is a gaseous growth substance produced in most plant organs, it promotes ripening of fruits; abscission of fruits and flowers; promotes flower initiation; it also stimulates growth by breaking seed/fruit dormancy

(d) **Abscisic acid (ABA)**
Abscisic acid is a major inhibitor in plants and is antagonistic to all the three classes of growth promoters.

Role of abscisic acid

- Maintains leaf dormancy
- Causes stomata closure
- Causes seed dormancy
- Promotes fall of leaves and fruits

Activity 1: Using the information discussed above, Draw the venn diagram below in your note book. Write the roles of auxins, gibberellins, cytokinins in the suitable regions labelled A to G



Question; Which role(s) is/are

i) Common to all the three?
ii) Common to auxins and gibberellins?

Commercial use/economic importance of plant growth substances

a) As selective herbicides
They are applied to leaves from which they are translocated to the rest of the plant where they alter the growth and metabolism of the plant e.g some herbicides destroy broad leaved weeds from cereal fields

b) As fruit ripeners for example ethene, if it is applied on fruits, it causes them to ripen. This is useful to fruits like bananas which are picked and shipped when still green but must be sold when ripe(yellow) so they are sprayed with ethene while in transit
c) As growth promoters; e.g indole acetic acid(IAA) in root powder induces root formation when applied to stem cuttings. It can also be use to break seed dormancy
d) As growth retarders ; these retard growth of plants and limit them to heights easy to harvest
e) Flower and fruit inducers; IAA and gibberellins can be used to induce early flowering in crops; when IAA is applied to unpollinated flowers of tomatoes, fruits form without fertilization(pathenocarpy)

Lesson 8
Topic: Co-ordination

Sub-topic: **Response and behavior in animals**

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

- explain how types of behavior result from sequential responses
- Relate learning and response for survival in the environment

Introduction
A behavior is a change in activity of an organism in response to a stimulus. Animals that respond to stimuli in their environment appropriately have better survival chances that those that don't. some behaviors are inborn(innate) while others are learnt

Instinctive/Innate behavior
Instinctive behavior
.
instincts are

- inherited and not acquired. That is, they develop independent of the environment
- usually of immediate adaptive value to the organism.
- produced unconsciously in response to sudden change in the environment.
- similar in all members of a species and develop even in isolation

Task: Fill in words in the blank spaces in order to come up with a meaningful definition of innate behavior
From the above characteristics, we can define instinctive/innate behavior as:
is an ……(innate), stereotyped response to one or more environmental ……., characteristic of……..of a given species.

What are the **advantages of innate/instinctive behavior**?
Activity 1 Complete the following statements by filling in a suitable words (organs, short, parental) to come up with advantages of instinctive/innate behavior

a) Innate responses are generally ……., organisms can therefore react quickly to their environments, e.g. the earth worm quickly withdraws into its burrow, away from the danger.
b) Innate behavior suits species that have short lifespans; they don't have……to learn behaviors
c) Suits species with no …… care as they can't learn behaviors from other members of the species

Instinctive behaviors include

1. **Reflex**:

A reflex is a simple act of behavior in which a stimulus produces a specific short-lived response for example pulling a hand away from hot surface, baby feeding.
Reflexes enable bodies to respond quickly to a stimulus protecting them from harm

What are the importance of reflex behavior?
The rapid response to a stimulus, helps minimizes any damage to the body from potentially harmful conditions, such as touching something hot; knee jerk help us in balance . Reflexes reduce energy that would be required to plan and actively execute every tiny movement we make.

2. **Orientation behaviors:** are coordinated movements (walking, flying, swimming, etc.) that occur in response to an external stimulus. Orientation responses can be directional(taxes) or non-directional(kineses). However animals are capable of much more complex orientation-based behaviors such as migration and territorial behavior

Activity; read the examples of kinesis and taxis provided below and come up with the definitions of taxis and kinesis

Examples of Kinesis,

- woodlice moves around rapidly and randomly when exposed to light until they find better conditions then they stop moving or move slowly.
- When a light is turned on, the cockroach will quickly start running - not necessarily away from or towards the light

Definition of kinesis……

Examples of taxis

- Fly maggots move away from light sources (negative **photo taxis**)
- Euglena swims towards light. Euglena is said to be positively photo tactic. Earth worms more away from light and are therefore negatively photo tactic

Definition of Taxis……..

Question: Basing on the examples provided above, state any three differences between taxis and kinesis

Ecological importance of taxis

(i) Helps an organism to find food
(ii) Enables an organism to avoid unfavorable environment.
(iii) Enable organism to find mates

Ecological importance of kinesis

It increases the chances of finding resources and favorable conditions by sheer luck

Complex instinctive Behaviors
Migration
This is the movement of from one region to another and their return to their original habitat some other time
This is the Inborn, seasonal, long-distance travel whole populations to from one region to another, usually with a return. :In this case an organism is capable of detecting compass direction using cues from the environment and also capable of detecting its position as well as orientation. Migration is triggered by seasonal changes in weather, air temperature or day length, or changing food supply. Examples: wildebeest move towards rain in the dry season, some animals move from one food source to another, while others migrate to particular breeding areas.

Examples of migration:

(i) Some species of Gallinaceous and raptorial birds migrate from valley to mountain peaks.
(ii) Salmon return to native streams to breed after several years at sea.
(iii) Some sharks, whales (northern oceans for calving, southern areas for breeding) and other marine mammals - engaged in long distance oceanic migrations
(iv) Deer and Caribou, African ungulates (mammals engaged in overland migrations).

Cues that animals use to navigate
These may be hormonal (Endogenous) or - external cues from the environment (Exogenous)

Examples include
. Sun compass - movement of sun; angle of sun; polarized light (pattern of light based on sun's position and reflection on water); Geomagnetic compass - sensitivity to magnetic North and the earth's magnetic field; Star compass or position of moon; Other visual cues - patterns of waves; cloud patterns; landmarks; Smell and Sound

Territorial behavior
A territory is an area (or volume) of the habitat which is occupied by an individual or group and defended from others of the same species

Function of a territory

(i) It limits mating to fit individuals produce vibrant off springs
(ii) Exclusive access to food; some animals hunt in groups
(iii) Allow one sex, usually the male to defend an area to which female are attracted for mating

Task: Based on the already given facts, state other four functions of a territory.

Disadvantage of territory

(i) Weak animals are denied a chance to mate
(ii) Limits population density and other good qualities are lost
(iii) Promote spreading of diseases
(iv) May lead to extinction in case of disaster.

Social behavior

This is where animals live in groups. Which examples of animals do you know that leave in groups?

Advantage of social behavior

(a) Species in large groups suffer less predators even when the predator is successful; The chance that one is picked is very low.
(b) Predators are more successful at catching large prey when hunting in groups than when hunting on their own.
(c) Wood lice buddle together and survive desiccation better.
(d) Honey bees build hives with an internal air- conditioning system created by thousands of worker bees fanning with their wings

Disadvantages of group

(a) Competition for food
(b) Competition for male and some monopolize female.
(c) Intraspecific competition may be a means of regulating population size
(d) Reduces individual's chances of being eaten

Task; suggest any other three advantages and three disadvantages of social behavior

Reproductive behaviour

For an organism that reproduces sexually reproductive success depends on finding a mate.

Choosing a mate

If must be emphasized that the phrase choosing a mate does not imply that organism consciously try to decide with whom to mate. For the vast majority of species 'decision' made one almost certainly subconscious.

At the most basic level a mate must be an individual of the same species but the opposite sex. In many species what ensure that the right individuals mate with each other is courtship.

Courtship

This is a complex behavior pattern designed to stimulate organism to sexual activity, and is associated with pair formation in those species where both sexes are involved in rearing off springs such as baboons. Courtship behavior is controlled primarily by motivational and releasing stimuli and leads to mating. A variety of signals used in courtship to attract member of the opposite sex include sight, sound, smell, etc.

What are the Functions of courtship.

a. Allows the male mate with female when gonads are functional
b. It enables the mates to select opposite sex with the best quality enabling the community to evolve into better adapted individuals.
c. It tightens the bond between the mating pair.
d. Enable the male and female to look after the off spring together.
e. Synchronization of gonadal development so that the gametes mature at the same time.

Communication.

The ability of animal to communicate with one another is essential to animal behavior.

Communication between two individuals involves:

The message conveyed from one individual to another((Signal); The individual who transmits the signal (sender); The setting in which communication occurs. (context); The medium in which the signal is transmitted(a channel e.g. chemical, auditory or tactile]; Individual who detects the signal(receiver) The rules which enable the receive to translate the signal.(a code)

Communication may be among individuals in a population (intraspecific) or between individuals of different species(interspecific)

The importance of communication to animals can be illustrated by the phenomenon of territorial.

Learning

It refers to a more or less permanent change in behavior which occurs as a result of experience. Animals vary in how much they are capable of learning. The more advanced an animal brain is, the more it can learn though much of the brain has nothing to do with learning.

The extraordinary capacity for learning among humans to learn is due to enlarged cerebral hemispheres with extensive cortical folding and organization.

Types of learning.

1. Habituation

Is reduced response of an animal to a repeated stimulus which is associated with neither benefit nor harm. Lack of continued response to strong odors is a common example of sensory habituation

Importance of habituation

(i) Enables a young animal to understand neutral elements in the environment such as movements due to wind.
(ii) It enables an animal to save energy by not responding to non-harmful stimuli over and over again.
(iii) Habituation helps to eliminate unnecessary responses.
(iv) Helps an animal filter large amount of information received from the surrounding environment.

2. Associative learning or conditioning

This is any learning process in which a new response becomes associated with a particular stimulus. It is classified as **classical conditioning** and **operant condition**

(a) Classical conditioning

Classical conditioning is the process by which a naturally occurring stimulus is paired with a stimulus in the environment, and as a result, the environmental stimulus eventually elicits the same response as the natural stimulus.

For example, A feeling of hunger in **response** to **the** smell.

(b) trial and error learning /Operant conditioning

This is a type of learning where behavior is controlled by consequences that is reward or punishment.

3. Latent learning

Animal learn about something unintentionally but the knowledge become useful at the time when it's necessary.

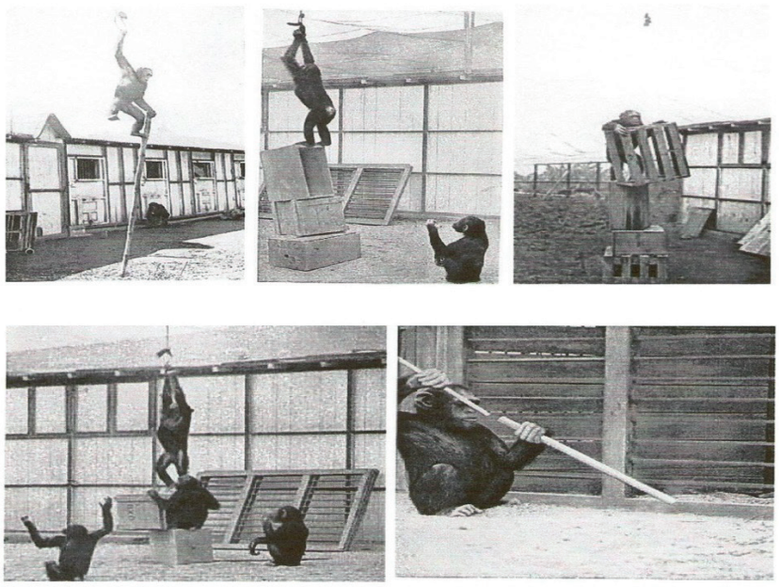
Latent learning is important because in most cases the information we have learned is not always recognizable until the moment that we need to display it

Latent learning is Important for socialization process, as children learn how to behave and respond to others by observing how their parents and other caregivers interact with each other and with other people

4. Insight learning

It occurs when an animal solves unfamiliar problem apparently by looking at it, assessing the situation and the arriving at a solution. The first experiment which demonstrated this type of learning in non-human were done on chimpanzees. The chimpanzees were presented with a bunch of banana too high to reach. The images below show some parts of the experiment.

Task: Study the images, and write down the learning behaviors displayed by the chimpanzees in order to reach the bananas.



Insight among chimpanzees

Intelligence: Intelligence is the ability of an animal to solve unfamiliar problems.

5. Imprinting

You might have seen or heard that chicks, duckling and goslings follow the first moving object they see after hatching. This form of learning is called imprinting. The object is usually their mother but they seemingly can be imprinted on any object such as a human or a red ball, if it's the first moving object they see during a sensitive period(time during which the behavior develops) of two to three days after hatching.

Importance of imprinting behavior

(i) It enables the young animal to recognize its own mother from among the other adults of its species.

(ii) In early childhood, human become imprinted on their brother and sister and subconsciously learn not to mate with them subsequently to prevent inbreeding.

(iii) Enable animals to visually identify with other members of their species so they may choose appropriate mates later in life.

(iv) Enable young one to get food from their parents.

6. Displacement activity

Displacement behavior are inappropriate behavior (out of context) which are sometimes displayed by animals when is in state of internal conflict such as fear and aggression.

When an animal is confronted with several alternative courses of action, it may perform what appear to be an irrelevant behavior, **Importance of displacement activity**
It may be away of releasing stress

Activity: Basing on the definitions of learning types we have discussed above, indicate a type of learning that corresponds to each example given

a) Scratching an ear and unnecessary running a hand through one's hair under conflict.
……..

b) Birds soon ignore the scarecrow which prevented them from landing when it was first placed in a field.
……

c) A student tends to complete his/her homework daily; because he/she knows that he/she will be rewarded with a sweet (action) or praise (behavior).
……

d) Students or children will follow rules strictly to avoid being nagged by the teachers or parents. So, to avoid nagging, the child might end up following the rules strictly. Similarly, army personnel also have to follow the strict routine to avoid disciplinary actions against them; it shapes them into a disciplined individual.
……..

e) A student is taught how to perform a special type of addition, but does not demonstrate the knowledge until an important test is administered
……

f) Saliva secretion elicited by the sight, smell of food or ringing a bell for lunch.

……

Altruism

Altruism is a disadvantageous behavior for an individual performing the behavior, but helpful to another individual e.g. worker honey bees are altruism in that they help their mother to produce off spring rather than lay eggs themselves.

In summary, animal behaviour can be innate or learned; innate/instinctive behaviour include simple responses such as reflexes, taxes and kineses. The more complex innate behaviors include migration, territoriality, courtship etc. learned behaviors include insight, trial and error, habituation, imprinting, classical conditioning, latent learning and displacement activity

Lesson 9

Topic: Coordination
Sub-topic: Hormonal coordination in animals
By the end of this lesson, you should be able to;

- Describe the structure and function of the endocrine system
- Explain the principal of negative feedback mechanism of hormonal action

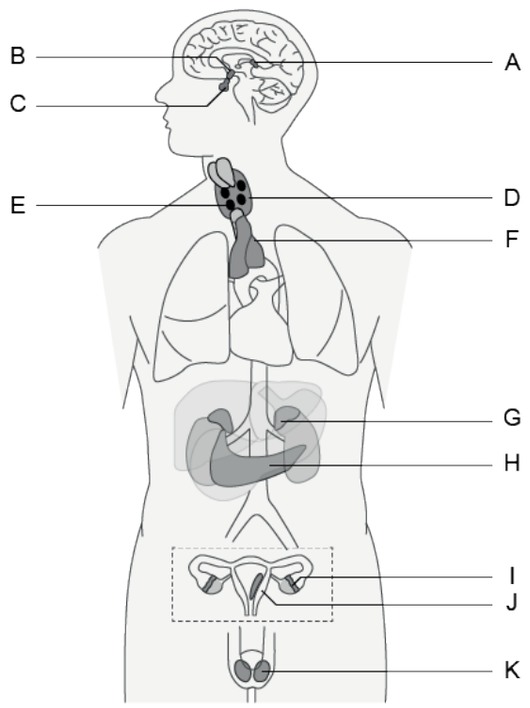
Introduction

A hormone is an organic compound produced in one part of the body, from which is transported -usually in the blood stream to another part where it evokes a response.

Position of the main endocrine glands in a human body

Activity 1: On the figure below name the parts labelled A to K, Pick a suitable word from the box below.

Pituitary gland	Adrenal gland	testis,	pancreas(islets of Langerhans,
ovary,	thyroid gland	parathyroid gland,	Thymus gland, pineal gland, placenta(during pregnancy)	hypothalamus



Name the parts;

A…… **E**……
I……
B…… **F**……
J……
C…… **G**……
K……
D…… **H**……

Functions of the hormones
Activity 2, study the table below to fill in the blank spaces by picking word(s) from the box below the table.

Endocrine gland	**Hormone and chemical nature**	**Functions**
Pineal gland	Melatonin-derived from the amino acid tyrosine	(1) Antagonistic t to FSH / LH (2) Regulates biological / circadian rhythms e.g. sleep
2) Thyroid gland (amine hormone)	**a**……	((a) Controls bas al metabolic rate (BMR). All organs / systems of body res pond to thyroxine.
	(b) Thyrocalcitonin (Peptide)	b) Facilitates Ca+2 absorption
Parathyroid gland	……	*Ca+2 and PO–4 metabolism m.*
Thymus	Thymosine (polypeptide)	Anti-FSH and LH; delays puberty
(5) Is lets of Langerhans (Pancreas) (i) alpha-cells (ii) beta-cells (iii) d-cells	(i) Glucagon (ii) …… (iii) Secretin (polypeptide)	(i) Gluconeogenesis/Glycogenolysis (ii) Glycogenesis (iii) Gastric functions
Adrenal gland (a) Adrenal medulla	(a) Epinephrine (adrenaline)	) Stresses/ emergency/Fright, Fight and Flight increases heart beat and muscle activity, etc.

	b) Norepinephrine (noradrenaline), peptide	
……	b) Mineral corticoids and glucocorticoids derived from cholesterol	Electrolyte and carbohydrate metabolism.
(7) Ovary (a) Granulosa cells	…… (Steroid)	Secondary sexual characteristics, primary action on uterine endometrium mitogenic.
b) ……	Oestrogen and Progesterone (Steroid)	Secreted during luteal phase e of menstrual cycle in human female and estrous cycle of other mammals . Prepares uterine endometrium for receiving blastocytes for implantation. Progesterone is also anti-FSH and anti-LH
8. Placenta temporary endocrine gland formed during pregnancy	Steroids secreted are Oestrogen and progesterone (b) Relaxin -Polypeptide	(a) Maintenance of pregnant state prevents lactogenesis, follicogenesis and Ovulation. (b) Act on pubic symphysis is and enlarges the birth canal to facilitate birth (parturition).
(9) Testis (i) Sertoli cells (sustentacular cells)	Inhibin – Polypeptide	Inhibits FSH action and weakens spermatogenesis
……	Testosterone (Steroid)	(i) Pubertal changes in male (ii) Secondary sexual characters in male (iii) Sex drives (iv) Spermatogenesis

Thyroxine, iodinated amino acid called tyrosine

Leyding cells

(Interstitial cells)

Oestrogen (estradiol)

Insulin

Corpus luteum

Adrenal cortex **Parathormone(Peptide)**

HYPOTHALAMUS

It is connected with anterior pituitary lobe by blood capillaries and with the posterior pituitary lobe by axons of its neurons.

Hormones of hypothalamus

Neurosecretory cells of hypothalamus secrete hormones called releasing factors (RF) or inhibiting factors (IF), which are carried to the anterior pituitary lobe (primary target organ) and stimulate or inhibit the release of trophic hormones**.**

PITUITARY GLAND

It is divided into Anterior lobe and Posterior lobe

Pituitary Hormones

The hormones secreted by Pituitary are either secreted by the Hypothalamus or are stimulated by the hormones secreted by Hypothalamus e.g. Thyrotropin releasing hormone which stimulates release of TSH.

The table below show the hormones secreted by the pituitary gland

Anterior lobe	Middle lobe	Posterior lobe
a. Adrenocorticotropic hormone (ACTH) b. Thyroid Stimulating Hormone (TSH) c. Follicle Stimulating Hormone (FSH) d. Lutenizing Hormone (LH) e. Growth Hormone (GH) **f.** (Prolactin	Melanocyte Stimulating Hormone	Oxytocin (OT) Antidiuretic Hormone or Vasopressin (ADH)

What is the chemical nature of Hormones?

Based on their chemical nature, hormones can be grouped into four types; Peptide/protein hormones e.g., insulin, glucagon, TSH, LH, FSH ;Steroid hormones e.g., cortisol, testosterone, progesterone, adrenaline; Iodothyronines e.g., thyroid hormones and amino acid derivatives e.g., epinephrine

How do hormones work?

Activity 3; choose a suitable word from the box provided below to fill in the gaps in the following passage in order to come up with a meaningful description of how steroid hormones function

a) mechanism of steroid hormonal action

Generally a steroid hormone works through activation of a

Steroid hormones are not……., so they travel in blood attached to protein carriers. On arrival at their……., they dissociate from the protein carrier, pass through the plasma membrane of the cell into the cytoplasm.

In the cytoplasm, some steroid hormones bind to specific receptor proteins and then move as a…….. complex into the nucleus via nuclear pore. Others travel directly into the nucleus and then bind to specific receptor proteins. The hormone-receptor complex is now activated to bind to specific regions of DNA called **hormone -response elements.** The binding of the hormone-receptor complex activates specific genes in the DNA which transcribes……..

. mRNA then passes into the cytoplasm via nuclear pore and functional ribosomes attach to it to allow translation. ……chains are synthesized, which form specific enzymes required for causing a physiological response. e.g. if the steroid hormone is……., it stimulates the repair and thickening of endometrium.

water-soluble, hormone – receptor, target cells, messenger RNA Peptide, oestrogen

b) Mechanism of non-steroid hormonal action

A non-steroid hormone, being insoluble in lipids, cannot diffuse through the plasma membrane but acts as

first messenger and binds to its receptor in the plasma membrane of target cells

Bound receptor interacts with and, through a set of G proteins, turns on adenylate cyclase enzyme, which is also an integral membrane protein.

The activated adenylate cyclase enzyme then converts ATP to cyclic adenosine monophosphate (cAMP), hence increasing the intracellular concentration of cAMP. The cAMP acts as a **second messenger**, which then activates other enzymes. cAMP in the cytoplasm enables binding of protein kinase A with cAMP to become catalytically active. Active protein kinase A adds phosphates to other enzymes in the cell, causing them to become catalytically active. This **cascade effect**, where the action of one enzyme in turn activates another enzymatic reaction results in many product molecules.

The principle of negative feedback

Hormone control many cell activities and are very important during homeostasis, however hormones production its self must be controlled. What controls hormones themselves? Most hormones are regulated by feedback mechanisms in which a product feeds back to control its own production.

Most hormone feedback mechanisms involve negative feedback; few involve positive feedback
During negative feedback, increase in levels of a particular hormone will result in a decrease in its production.

Let us consider secretion of thyroid hormones as an example

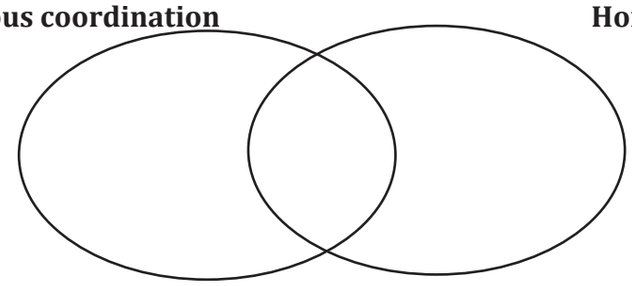
Activity 4; Basing on what has been already discussed above about negative feedback, Complete the passage below by filling in a suitable word; in order to come up with a meaningful description of negative feedback

The …….. secretes thyrotropin-releasing hormone(TRH). TRH stimulates the …….. to produce thyroid-stimulating hormone(TSH). The TSH in turn stimulates the thyroid gland to secrete its hormones such as thyroxine. When the level of thyroid hormones is …….. enough, these hormones *give* feedback to stop the production of …….. from the hypothalamus and hence …….. from the pituitary gland. Without production of TSH, the thyroid gland stops secretion of its …….. With time, the level of thyroid hormones fall too low, what do you think happens

Meanwhile, positive feedback occurs when a product feeds back to increase its production and this causes conditions to become increasingly extreme.
A good example of positive feedback is milk production by a mother for her baby. As the baby suckles, nerve signals from the nipple cause the pituitary gland to secrete prolactin. The prolactin in turn stimulates mammary glands to secrete milk, so the baby suckles more and this causes more prolactin to be secreted and more milk to be produced.

Task: compare nervous coordination with hormonal coordination

Nervous coordination **Hormonal coordination**



Lesson 10

TOPIC: Reproduction, Growth and Development
Sub topic: Sexual Reproduction in Animals
Specific objectives:
By the end of the lessons, you will be able to:

- Describe the stages of oogenesis and spermatogenesis processes.
- Describe the relationship between the stages of oogenesis and spermatogenesis
- Explain the significance of gametogenesis.

You will need pre-requisite knowledge on:

- *Structure of the male and female reproductive organs in man*
- *The process of mitosis and meiosis.*

Introduction

Sexual reproduction in animals involve joining or fusion of reproductive cells called gametes to form a zygote. The zygote divides by mitosis to form many cells which differentiate to form body tissues and body organs. You remember that normal human body cells contain 46 chromosomes (23 homologous pairs of chromosomes). If each gamete cell contained 46 chromosomes the total number of chromosomes would be 92 in the zygote. This would be an abnormal number and if such a zygote developed into an organism, it would not be a human being. *Try to explain why?*

Question 1: *What should the body do to maintain the normal number of chromosomes in the body cells? Write a brief answer somewhere.*

To answer the above question you need to understand the process of gamete formation in the body. The process of gamete formation is called gametogenesis.

Question 2: *How many types of gametogenesis are there in human?*

Do you remember the types of gametes in human? Yes they are two: the sperm and the ovum (egg). The sperm is found in male (man) while the ovum is found in female woman). Therefore, there are two types of gametogenesis:
1. Spermatogenesis: Involving formation of sperms in the males and
2. Oogenesis: Involving formation of the ova in females.

Both types involve 3 phases: multiplication phase, growth phase and maturation phase. (you will see these phases in the illustrations).
Both take place in the **gonads** namely: **testes** in males and **ovaries** in females where mother cell are found. In males the mother cells in the testes are called **spermatocytes** while in females the mother cells are called **oocytes**.

In both processes, the number of chromosomes in the nucleus is halved from two sets (2n: a diploid condition) to one set of chromosomes (n: a haploid condition) by a process called meiosis.

Question 3: *What is involved in each type of gamete formation?*

Spermatogenesis:
Spermatogenesis in man occurs in the testes.

1. Germinal epithelial cells (2n) of the seminiferous tubule divide by mitosis to produce diploid **spermatogonia** (2n).

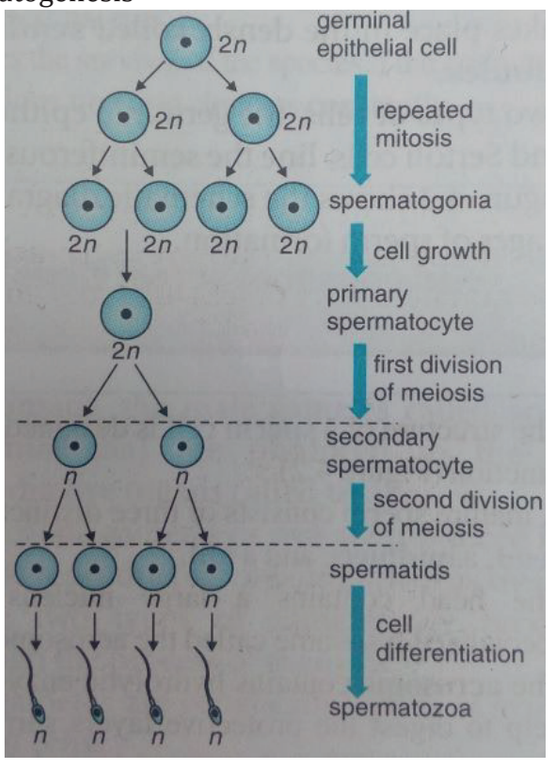
2. The spermatogonia grows to become primary **spermatocytes** (gamete forming cells) which are large diploid cells.

3. Each primary spermatocyte under goes first meiosis to form two haploid **secondary spermatocytes (n)**

4. Each secondary spermatocyte under goes a second meiotic division to produce two **spermatids**. *How many spermatids are finally formed?*

5. The spermatids obtain nourishment from nutritive cells called sertoli cells, develop tails and mature into **sperms** (spermatozoa) through cell differentiation.

Illustration of spermatogenesis



Oogenesis

Oogenesis occurs in the overlies of female,

1. **Primordial germ cells** (2n) divide mitotically to form **oogonia** the grow into **primary oocytes (2n)**

2. Primary oocytes (2n) undergo the first meiotic division to form two haploid cells called **secondary oocyte**s (n). One of the secondary oocyte (n) receives almost all the cytoplasm. The other is a **polar body,** it may disintegrate or divide again.

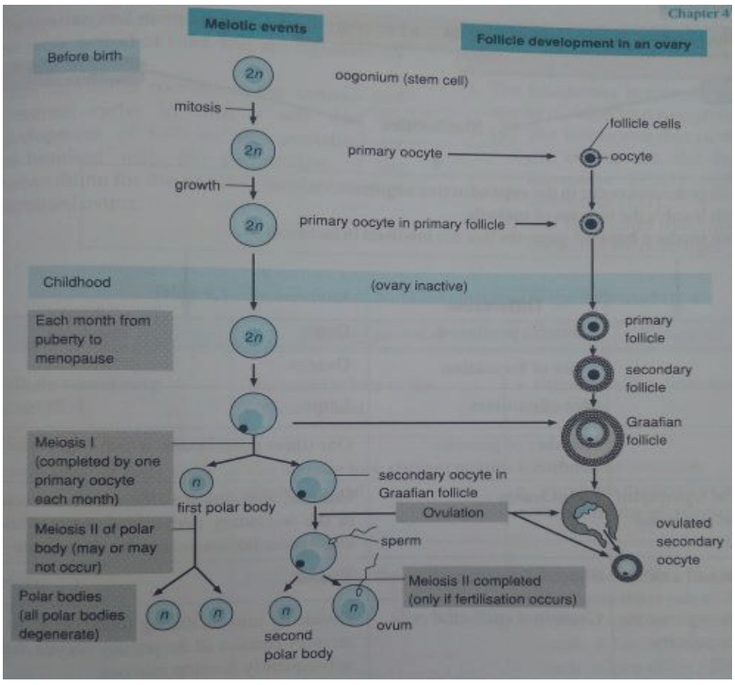
3. The secondary oocyte (n) begins meiosis II and stops at metaphase II.

4. Then at ovulation, it leaves the ovary and enters an oviduct where it is approached by a sperm.

5. When a sperm enters the oocyte, the oocyte is activated to continue meiosis II to completion. The mature egg is haploid. Meiosis in female produces only one egg (ovum) and possibly three polar bodies.

6. The polar bodies are used to discard unnecessary chromosomes.

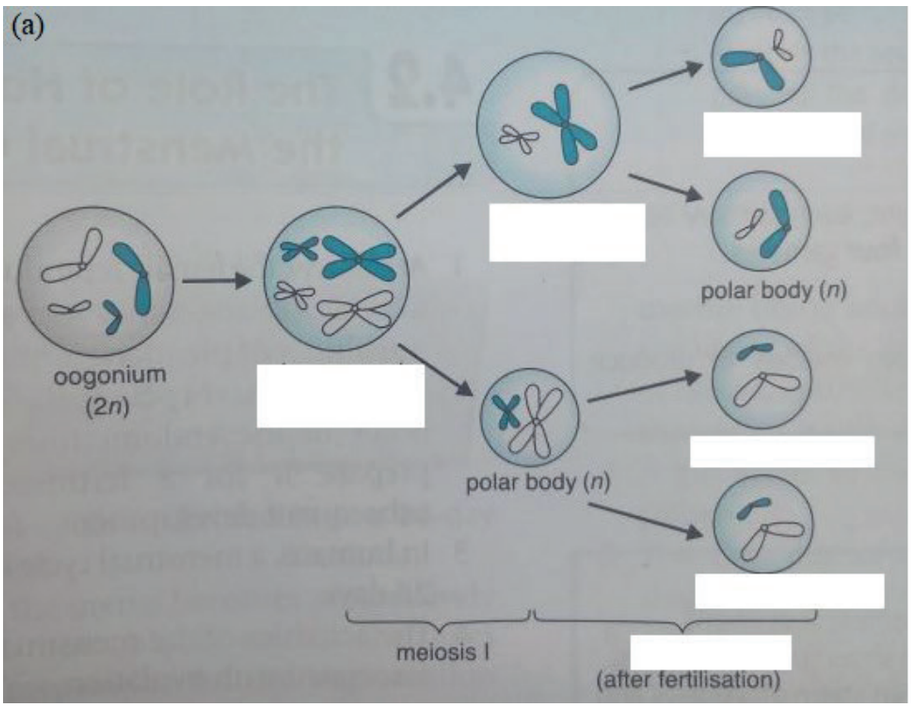
The cytoplasm serves as a source of nutrients to the developing embryo.



Follow up:

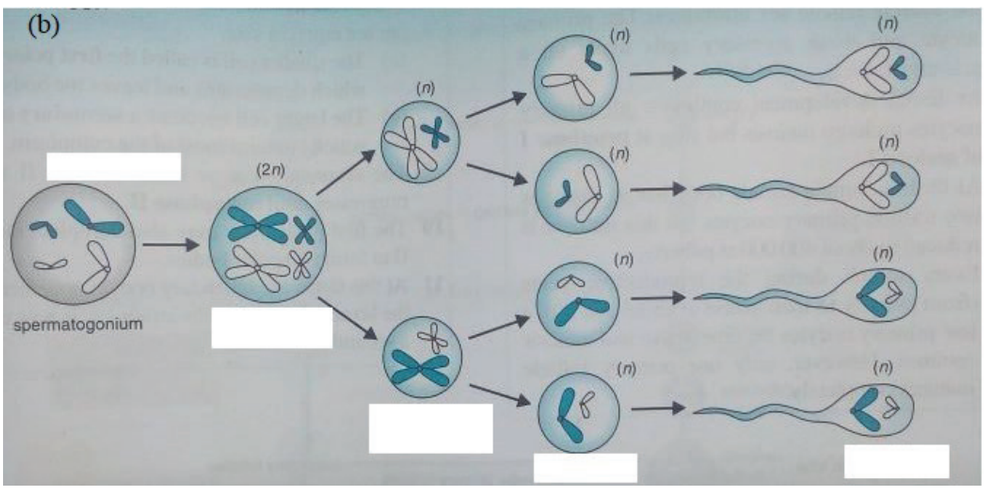
What are the diagrams below illustrating?

Using the words or numbers from the lists of alternatives, fill in the gaps on the diagrams.



List of alternatives

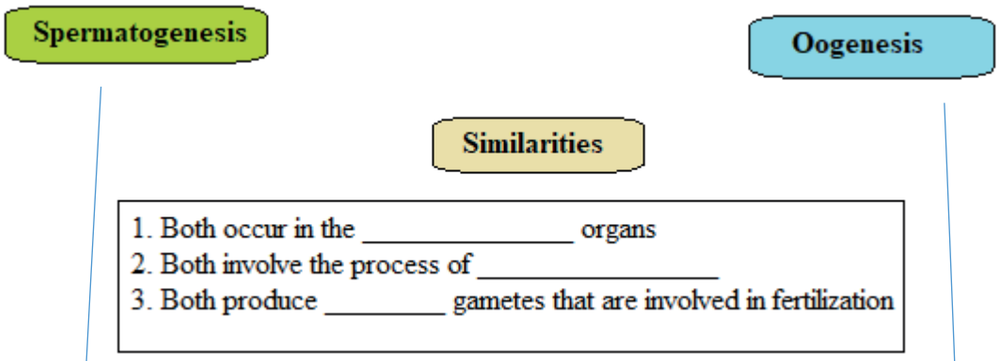
- secondary oocyte (*n*)
- polar body (*n*)
- ovum (*n*)
- meiosis II
- primary oocyte (2*n*)



Alternative list

- sperm
- secondary spermatocyte
- primary spermatocyte
- spermatid
- (2*n*)

Summary:
Comparison between spermatogenesis and oogenesis



	Differences	
	Gametes produced	
	Place of formation	
	Size of gametes	large
	Number of gametes produced during meiosis	
	Cytokinesis (distribution of cytoplasm in new cells)	
	Shape of gametes	
After puberty, divide by meiosis throughout adulthood of men.	**Germinal epithelial cells**	Divide by mitosis during foetal stage. At birth, an ovary contains all primary oocytes that will subsequently develop in ova.
Occur _____ in an uninterrupted sequence.	**Occurrence of meiotic cell division**	Is not continuous, starts and stops at prophase I and metaphase II. Meiosis II is completed only if fertilization has occurred.

i. *Explain why gametogenesis is important in animals.*
ii. *Can you now cross check the answer you wrote for question 1 in this lesson and make correction if you were wrong.*

Lesson 11

Topic: Reproduction
Sub topic: Sexual Reproduction in Animals
Specific objectives:
By the end of the lessons, you will be able to:
Explain the physiological changes in females during pregnancy.
Explain gestation period and birth
Discuss the events and role of hormones in menstrual cycle

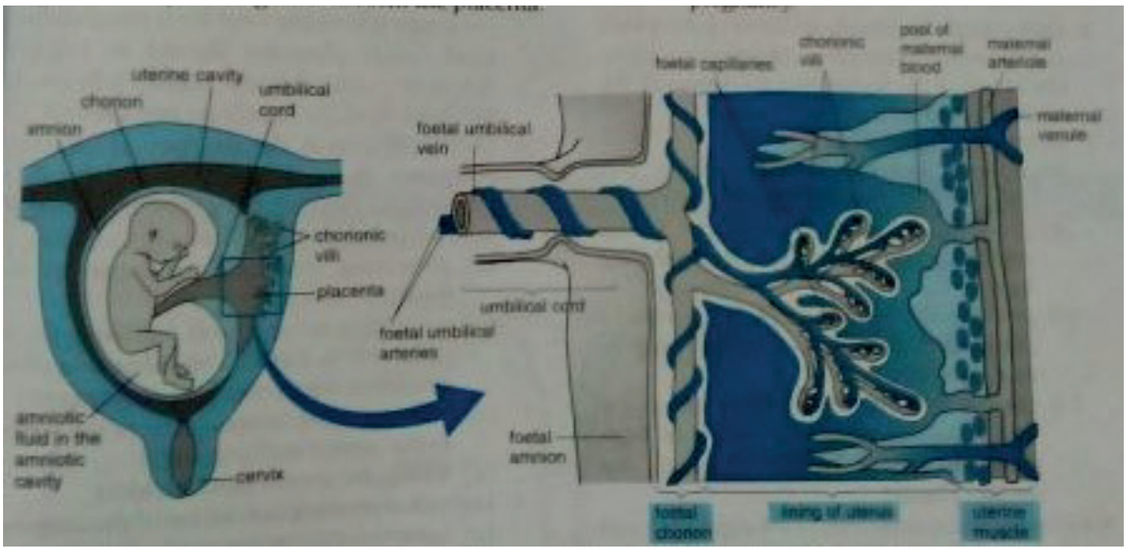
Introduction
In sexual reproduction, the sperm and the ovum nuclei fuse to form a single nucleus called the zygote. Fertilization occurs in the female's fallopian tube and the zygote remains in the woman's body after implantation in the womb. Implantation marks the start of pregnancy. When fertilization occurs, menstruation stops and a nine month **gestation** period starts. This period is also known as **pregnancy**. Menstruation is disrupted during the entire gestation period.

What happens after fertilization?
Remember a zygote is a single cell but an organism is made up of several cells resulting from the zygote. So what happens to the single celled zygote?
After fertilization the zygote divides mitotically to form a hollow ball of cells called the **blastocyst**. The blastocyst moves and gets implanted in the lining of the uterus (endometrium). The outer layer of the blastocyst develops into the embryonic membranes, the **chorion** and the **amnion.** The chorion develops villi (finger like structures) which grow into the uterine wall tissues. These villi absorb nutrients from the uterine wall. The villi form part of the placenta which is connected to the fetus by the **umbilical cord.**
The amnion forms a membrane around the fetus and encloses a watery fluid called **amniotic fluid** around it. The amniotic fluid cushions the fetus to avoid physical damage.

The placenta
- The chorionic villi form the fetal side of the placenta while the uterine lining forms the maternal side of the placenta.
- At the placenta, the mother's blood capillaries and fetal blood capillaries come into contact but do not join. *If the fetus is getting nourishment from the mother, why don't the blood vessels join? (Hint: fetus blood vessels are just developing and they are tender, maternal blood is at a high pressure and blood groups).*
- The placenta is connected to the fetus by the umbilical cord.
- The umbilical cord is a tube with one umbilical vein and two umbilical arteries. *Why two umbilical arteries?*
- The umbilical arteries carry de-oxygenated blood from the fetus to the placenta.

- ❖ The umbilical vein carry oxygenated blood from the placenta to the fetus.

The placenta showing the relationship between the blood capillaries of the fetus and the maternal blood stream



Functions/roles of the placenta during pregnancy

- ✓ It is the site of exchange of nutrients, respiratory gases (oxygen and carbon dioxide) and wastes between the fetus and the mother. This occurs without the blood mixing.
- ✓ It secretes oestrogen and progesterone the hormones that maintain a thick, blood enriched endometrium throughout pregnancy period (gestation period). Progesterone prevents ovulation and menstruation during pregnancy by stopping secretion of the follicle stimulating hormone (FSH).
- ✓ It allows certain antibodies to pass into the fetus to provide passive natural immunity against diseases.
- ✓ It is a barrier or filter that prevents entry of certain substances into the fetal blood. Therefore, it protects the fetus by:
  Preventing certain foreign bodies eg pathogens (disease causing organisms) from crossing into the fetal blood.
  Preventing maternal hormones and other chemicals e.g. drugs and alcohol from getting into the fetal blood.

Summary

(Use the following words to fill in the gaps below: mother's, blood groups, blood capillaries, fetus, high pressure, harmful bacteria, blood)

Even though the _____ _____ of the fetus and the mother's blood are close to each other, the _____ of the fetus and that of the mother do not mix. This is important because it:

i. Prevents certain _____ _____ and their toxins from entering the fetus.
ii. Prevents the action of chemicals in the mother's blood from harming the developing _____.
iii. Prevents the mixing of _____ _____ of the mother and the fetus which may be incompatible.
iv. Ensures that the tender blood vessels of the _____ do not burst as a result of _____ _____ caused by the flow of the _____ blood.

You remember gestation period in human is 9 months. *What happens after the 9 months?*
Pregnancy ends after the 9th month by the onset of birth. Giving birth is the process of expelling the baby out of the womb.
During pregnancy, the placenta continues to secrete progesterone and some small amounts of oestrogen. As pregnancy proceeds to nine months, the level of progesterone decreases while oestrogen level increases. These changes in hormone level starts the birth process by the posterior lobe of the pituitary gland secreting the **oxytocin** hormone. Oxytocin causes the walls of the womb or uterus to contract to start on the labour period.

Birth (parturition)

Birth has three stages:

1. Widening/dilation of the cervix leading to loss of the cervical plug. The embryonic membranes rapture to let out the amniotic fluid.
2. Pushing out of the baby from the womb
3. Expulsion of the placenta. This is sometimes called the after birth.

During pregnancy, progesterone and oetrogen hormones cause development of lactiferous (milk) glands in the mammary glands.
Following birth, the anterior lobe of the pituitary secretes a hormone, prolactin which stimulates the lactiferous glands to produce milk on which the baby feeds on after birth.
After giving birth, humans take care of the baby for sometime.

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