BIOLOGY

FOR

Senior Secondary School

3

AKADALEARN

SS 3
FIRST TERM NOTES ON
BIOLOGY

TABLE OF CONTENT

FIRST TERM

WEEK: 1

Biology SS 3 First Term

Topic: Regulation of Internal Environment (Homeostasis)

Introduction

Homeostasis is defined as the maintenance of a steady internal environment. In order words, homeostasis is the regulation of the internal environment of the body so as to maintain a steady state by self regulation, adjustments and provision of optimum conditions for normal and efficient functioning of the body cells.

An organism regulates its internal environment and keeps it in a steady state by constantly adjusting any changes in the physical and chemical conditions of its body fluids. These conditions include temperature, pH, osmotic pressure and concentrations of dissolved substances in the body fluids like carbon dioxide, oxygen, urea, food substances (glucose, amino-acids, etc.) and ions (sodium, potassium, chlorides).

Parts Involved in Homeostasis

The main organs and substances involved in homeostasis are:

- Kidneys
- Liver
- Skin
- Hormones (substances secreted by endocrine glands).

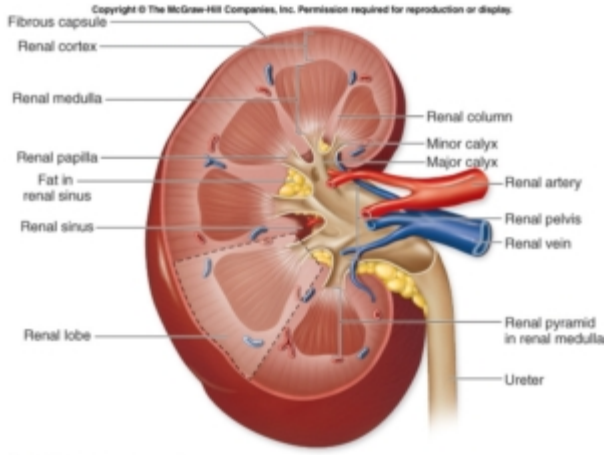
But the brain has overall control over the homeostatic processes in the body.

The Kidneys

The paired kidneys are the excretory organs of humans which help to regulate the internal environment.

Functions of the Kidneys

- The kidneys remove nitrogenous waste like urea and other ammonium compounds from the blood – the excretory function
- The kidneys control the amount of water, salt (Sodium, Potassium and Chloride ions) and acids (Potassium and Hydrogencarbonate ions) – the Osmoregulatory function.



Right kidney, coronal section

Water Balance

On cold day or when much water is drunk, we excrete a large amount of dilute urine when sweat is less. On hot days, we lose water from the body through sweating and we excrete small amount of concentrated urine. This is because the kidneys regulate the amount of water excreted in the urine in order to keep the osmotic pressure of blood constant. Increase in the osmotic pressure of blood is detected by osmoreceptors in the hypothalamus in the brain.

When there is an increase in the osmotic pressure of the blood, the osmoreceptors in the hypothalamus send nerve impulses to stimulate the release of anti-diuretic hormone (ADH) from the posterior pituitary gland. The ADH is carried by the blood to the kidneys where it causes an increase in the reabsorption of water by the tubules into the bloodstream. The urine becomes concentrated as its volume decreases, while the blood becomes diluted, and its osmotic pressure decreases. When the osmoregulators detect a normal osmotic

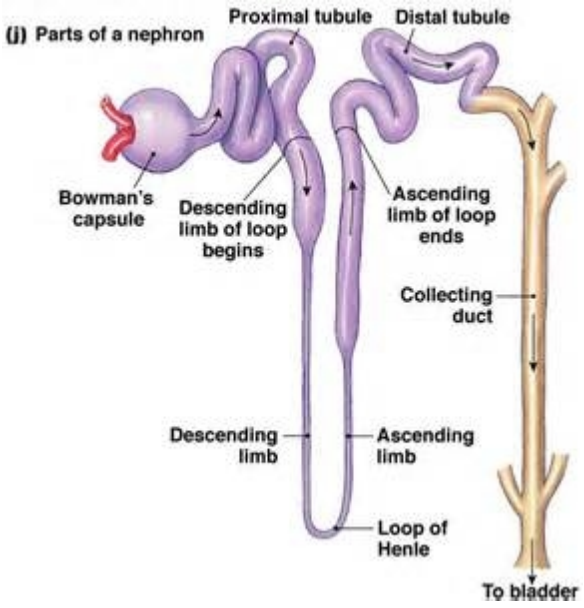
pressure, they stop stimulating the release of ADH and less water is reabsorbed by the kidneys and the urine produced is dilute.

Urine Formation

- Ultra filtration:It is the process of filtering materials from the glomerulus into the Bowman's capsule. As blood circulates through the glomerulus, ultrafiltration occurs. The blood is filtered blocking the passing of larger molecules like plasma proteins and the blood cells and allowing the small molecules such as water, urea, mineral salts, sugar to pass through the wall of capillaries and the Bowman`s capsule into the capsular space.

- Selective reabsorption: It is the process of reabsorbing useful materials back into the blood. The filtered fluid known as glomerular filtrate passes through the Proximal convoluted tubule and the Henle`s loop and this process allows selective reabsorption to take place. Water and useful substances like sugar, amino acids and salts are reabsorbed into the surrounding blood capillaries.

- Tubular secretion: The filtrate then moves into the distal convoluted tubule and tubular secretion occurs. Large waste molecules like creatinine and ions (hydrogen, potassium and hydrogencarbonate) if necessary are secreted into the tubules to keep the osmotic concentration of the blood constant. The fluid that eventually remains in the tubule is concentrated and is known as urine; this moves down through the ureter and collects it in the bladder. An average of 1.5 litres of urine is produced daily.



Diseases of the Kidney

1. **Diuresis:** It is a condition in which the cells of the kidney tubules are not reabsorbing water from the glomerular filtrate and as a result, a large amount of water is passed out in urine

Effects of Diuresis

1. It leads to loss of weight
2. It leads to excretion of large amount of urine

Remedy

1. Drugs such as diuretics should be administered to get rid of excess water in the body.
2. Surgical operation should be performed on the patient.
3. **Nephritis:** It is the condition in which the blood vessel in Bowman's capsule becomes inflamed and porous as a result of which they cannot carry out the function of ultra filtration completely.

Effects of Nephritis

1. Presence of amino acid in urine
2. Weakness of the body

Remedy

1. Use of dialysis
2. Kidney transplant
3. Use of antibiotics

3. **Kidney stones:** It is caused by some diseased growth within the tubules.

Effects of Kidney Stones

1. It obstructs the passage of urine.
2. Pain is experienced on passing out urine.

Remedy

1. Patient should avoid excessive intake of calcium.

2. Surgery called nephrectomy can be performed i.e. involves the opening up of the kidney over more stones.

The Liver

The liver is a large dark reddish-brown organ that weighs about 3 pounds, located in the upper right-hand portion of the abdominal cavity, beneath the diaphragm, and on top of the stomach, right kidney, and intestines.
There are two distinct sources that supply blood to the liver,

- Oxygenated blood flows in from the hepatic artery
- Nutrient-rich blood flows in from the hepatic portal vein

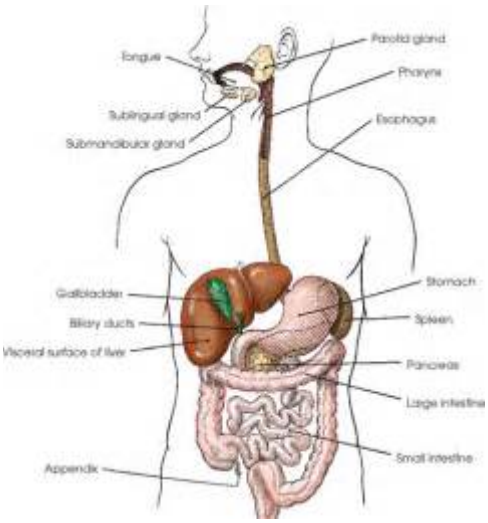
The liver holds about one pint (13 percent) of the body's blood supply at any given moment. The liver consists of two main lobes, both of which are made up of thousands of lobules. These lobules are connected to small ducts that connect with larger ducts to ultimately form the hepatic duct. The hepatic duct transports the bile produced by the liver cells to the gallbladder and duodenum (the first part of the small intestine). The liver can lose three-quarters of its cells before it stops functioning. In addition, the liver is the only organ in the body that can regenerate itself.

The peritoneum connects the liver in 4 locations: the coronary ligament, the left and right triangular ligaments, and the falciform ligament. These connections are not true ligaments in the anatomical sense; rather, they are condensed regions of peritoneal membrane that support the liver.

- The wide *coronary ligament* connects the central superior portion of the liver to the diaphragm.
- Located on the lateral borders of the left and right lobes, respectively, the *left* and *right triangular ligaments* connect the superior ends of the liver to the diaphragm.
- The *falciform ligament* runs inferiorly from the diaphragm across the anterior edge of the liver to its inferior border. At the inferior end of the liver, the falciform ligament forms the round ligament (ligamentum teres) of the liver and connects the liver to the umbilicus. The round ligament is a remnant of the umbilical vein that carries blood into the body during fetal development.

The liver consists of 4 distinct lobes – the left, right, caudate, and quadrate lobes.

- The left and right lobes are the largest lobes and are separated by the falciform ligament. The **right lobe** is about 5 to 6 times larger than the tapered left lobe.
- The small **caudate lobe** extends from the posterior side of the right lobe and wraps around the inferior vena cava.
- The small **quadrate lobe** is inferior to the caudate lobe and extends from the posterior side of the right lobe and wraps around the gallbladder.



Functions of the Liver

The liver regulates most chemical levels in the blood and excretes a product called bile, which helps carry away waste products from the liver. All the blood leaving the stomach and intestines passes through the liver. The liver processes this blood and breaks down the nutrients and drugs into forms that are easier to use for the rest of the body. Some of the more well-known functions include the following:

- Production of bile, which helps carry away waste and break down fats in the small intestine during digestion
- Production of certain proteins for blood plasma
- Production of cholesterol and special proteins to help carry fats through the body
- Conversion of excess glucose into glycogen for storage (glycogen can later be converted back to glucose for energy)
- Regulation of blood levels of amino acids, which form the building blocks of proteins
- Processing of hemoglobin for use of its iron content (the liver stores iron)
- Conversion of poisonous ammonia to urea (urea is an end product of protein metabolism and is excreted in the urine)
- Clearing the blood of drugs and other poisonous substances
- Regulating blood clotting

- Resisting infections by producing immune factors and removing bacteria from the bloodstream

When the liver has broken down harmful substances, its by-products are excreted into the bile or blood. Bile by-products enter the intestine and ultimately leave the body in the form of feces. Blood by-products are filtered out by the kidneys, and leave the body in the form of urine.

The Diseases of the Liver

Important diseases of the liver include the following;

(1) **Gall Stone**: These are stony masses that form in the gall bladder or bile duct as a result of the production of abnormal bile by the liver. Gall stone obstruct the flow of bile and causes inflammation of the gall bladder.

(2) **Viral Hepatitis**: There are two types of viral hepatitis. Hepatitis A and Hepatitis B. In both cases, the virus causes inflammation and destruction of the liver cells.

(3) **Cirrhosis**: This is a serious liver disease in which the damaged liver cells become replaced by useless fibrous tissue. Cirrhosis may be caused by excessive drinking of alcohol over a period.

(4) **Amoebic Liver Abscess**: The parasitic amoeba, *Entamoeba histolytica*, gets into the liver from the large intestine via the hepatic-portal vein, produces an enzyme that destroys liver tissues and causes an abscess to form.

Effects of Diseases of the Liver

The effects of liver diseases are due to failure of the liver cells to function properly. The most common signs and symptoms are:

- Weakness and tiredness
- Jaundices
- Slight fever
- Tendency to bleed and bruise easily
- High blood pressure in the hepatic-portal vein in cirrhosis.
- Oedema
- Mental changes such as apathy in most liver disease.

Remedy/Treatment

The liver has a high capacity to replace damaged cells and function normally. In most cases of liver diseases, the basic treatment procedures include:

- Rest, preferably in bed
- A nutritious but controlled low fat diet
- No taking of alcoholic drinks (for the rest of the patient's life in the of cirrhosis)
- Removal of liver disorder where possible, in the case of bile duct obstruction
- Liver transplanting.

Practice Questions

1. _____ is defined as the maintenance of a steady internal environment.
   a) Haemoglobin
   b) Homeostasis
   c) Cirrhosis
   d) Internal balance
2. One of the follwoing is not a disease of the liver____
   a) Gall stone
   b) Viral Hepatitis
   c) Diabetics
   d) Cirrhosis
3. One of the following is not a disese of the kidney ____
   a) Diuresis
   b) Nephritis
   c) Hepatitis
   d) Kidney stone
4. One of the following is not involved in Homeostasis
   a) Eyes
   b) Kidneys
   c) Hormones
   d) Liver

5. _____ is the process of filtering materials from the glomerulus into the Bowman's capsule
   a) Selective reabsorption
   b) Tubular secretion
   c) Filtration
   d) Ultrafiltration

Answers

1. B
2. C
3. C
4. A
5. D

WEEK: 2

Biology SS 3 First Term

Topic: Endocrine Gland

Hormone is a naturally occurring substance secreted by specialized cells that affects the metabolism or behaviour of other cells. In other word, hormones are chemical messengers secreted by ductless gland (endocrine gland). These messengers are sent out from one part of the body to affect cells in other parts of the body. Hormones are often released directly into the bloodstream for onward transportation to their target organs.

Hormones can have a wide range of effects on the body. They can cause mood swings, regulate the metabolism, control the reproductive cycle, induce hunger and cravings, stimulate or inhibit growth and prepare the body for changes such as puberty, childbirth or menopause.

Endocrine glands

These glands are also called ductless glands, since they lack excretory ducts. Instead, the secretors cells release their products, *hormones*, into the extra cellular space. From the extra cellular space, the hormones may enter the blood stream, by which they reach their target organs.

Endocrine Gland, Hormones and Their Functions

Hypothalamus

The hypothalamus is a part of the brain. It serves many different functions in the nervous system, and is also responsible for the direct control of the endocrine system through the pituitary gland.

Pituitary Gland

The pituitary gland, also known as the hypophysis, is a small pea-sized lump of tissue connected to the inferior portion of the hypothalamus of the brain. It is also called “master gland” because its secretion controls other glands. The pituitary

gland is actually made of 2 completely separate structures: the posterior and anterior pituitary glands.

Posterior Pituitary*:* is a small extension of the hypothalamus. The hypothalamus produced 2 hormones that are stored and released by the posterior pituitary:

1. Oxytocin triggers uterine contractions during childbirth and the release of milk during breastfeeding.
2. Antidiuretic hormone (ADH) prevents water loss in the body by increasing the re-uptake of water in the kidneys and reducing blood flow to sweat glands.

Anterior Pituitary: The anterior pituitary gland is the true glandular part of the pituitary gland. The function of the anterior pituitary gland is controlled by the releasing and inhibiting hormones of the hypothalamus. The anterior pituitary produces 6 important hormones:

1. Thyroid stimulating hormone (TSH), as its name suggests, is a tropic hormone responsible for the stimulation of the thyroid gland.
2. Adrenocorticotropic hormone (ACTH) stimulates the adrenal cortex, the outer part of the adrenal gland, to produce its hormones.
3. Follicle stimulating hormone (FSH) stimulates the follicle cells of the gonads to produce gametes—ova in females and sperm in males.
4. Luteinizing hormone (LH) stimulates the gonads to produce the sex hormones—estrogens in females and testosterone in males.
5. Growth hormone (GH) also known as pituitrin affects many target cells throughout the body by stimulating their growth, repair, and reproduction.
6. Prolactin (PRL) has many effects on the body, chief of which is that it stimulates the mammary glands of the breast to produce milk.
7. Oxytocin stimulates both the release of milk from nipples and contraction of uterus during birth.

Pineal Gland

The pineal gland is found posterior to the thalamus of the brain. The pineal gland produces the hormone melatonin that helps to regulate the human sleep-wake cycle known as the circadian rhythm.

Thyroid Gland

The thyroid gland is located at the base of the neck. The thyroid gland produces 3 major hormones: Calcitonin, Triiodothyronine (T3) and Thyroxine (T4).

Calcitonin is released when calcium ion levels in the blood rise above a certain set point. Calcitonin functions to reduce the concentration of calcium ions in the blood by aiding the absorption of calcium into the matrix of bones. The hormones T3 and T4 work together to regulate the body's metabolic rate. Lack of thyroxine in little children causes mental retardation and cretinism or dwarfism. But lack of thyroxine after maturity causes myxoedema (the person becomes physically and mentally sluggish and obese) and it can be treated effectively with thyroxine supplements.

Parathyroid Glands

The parathyroid glands are 4 small masses of glandular tissue found on the posterior side of the thyroid gland. The parathyroid glands produce the hormone parathyroid hormone (PTH), which is involved in the control of calcium content of the bone. PTH is released from the parathyroid glands when calcium ion levels in the blood drop below a set point. PTH stimulates the osteoclasts to break down the calcium containing bone matrix to release free calcium ions into the bloodstream. PTH also triggers the kidneys to return calcium ions filtered out of the blood back to the bloodstream so that it is conserved.

Adrenal Glands

The adrenal glands are a pair of roughly triangular glands found immediately superior to the kidneys. The adrenal glands are each made of 2 distinct layers, each with their own unique functions: the outer adrenal cortex and inner adrenal medulla.

Adrenal cortex: The adrenal cortex produces many cortical hormones in 2 classes: glucocorticoids and mineralocorticoids

1. Glucocorticoids have many diverse functions, including the breakdown of proteins and lipids to produce glucose. Glucocorticoids also function to reduce inflammation and immune response.
2. Mineralocorticoids, as their name suggests, are a group of hormones that help to regulate the concentration of mineral ions in the body. The most important of these hormones is aldosterone which increases the reabsorption of sodium ions by the kidney tubules.

Adrenal medulla: The adrenal medulla produces the hormones Adrenaline (epinephrine) and noradrenaline (norepinephrine) which are the emergency hormones. Both of these hormones help to increase the flow of blood to the brain and muscles to improve the "fight-or-flight" response to stress. These hormones also work to increase heart rate, breathing rate, and blood pressure while decreasing the flow of blood to organs that are not involved in responding to emergencies.

Pancreas

Pancreas is a large gland located in the abdominal cavity just inferior and posterior to the stomach. Within these pancreas are 2 types of cells—alpha and beta cells. The alpha cells produce the hormone glucagon, which is responsible for raising blood glucose levels. Glucagon triggers muscle and liver cells to break down the polysaccharide glycogen to release glucose into the bloodstream. The beta cells produce the hormone insulin, which is responsible for lowering blood glucose levels after a meal. Insulin triggers the absorption of glucose from the blood into cells, where it is added to glycogen molecules for storage.

Gonads

The gonads—ovaries in females and testes in males—are responsible for producing the sex hormones of the body. These sex hormones determine the secondary sex characteristics of adult females and adult males.

1. Testes: The testes are organs found in the scrotum of males that produce the testosterone in males after the start of puberty. During puberty, testosterone controls the growth and development of the sex organs and body hair of males, including pubic, chest, and facial hair.
2. Ovaries: The ovaries are located in the pelvic body cavity in females. The ovaries produce the female sex hormones progesterone and estrogens. Progesterone is most active in females during ovulation and pregnancy where it maintains appropriate conditions in the human body to support a developing fetus. Estrogens are a group of related hormones that function as the primary female sex hormones. The release of estrogen during puberty triggers the development of female secondary sex characteristics such as uterine development, breast development, and the growth of pubic hair.

Thymus: produces hormones called thymosins that help to train and develop T-lymphocytes during fetal development and childhood. The T-lymphocytes produced in the thymus go on to protect the body from pathogens throughout a person's entire life.

Plant Hormones and Their Functions:

Auxin: It promotes cell elongation e.g. tropic responses of plants. It stimulates cell division, e.g. root and fruit development. It also causes apical dominance and inhibits abscission.

Gibberellins: It promotes cell elongation, e.g. stem growth. It induces dormant seeds to germinate.

Cytokinins: It promotes cell division, e.g. stem, root and axillary bud growth. It inhibits ageing in leaves.

Abscisic acid: are growth inhibitors and induces dormancy, ageing and abscission e.g. suppresses growth of buds. It also controls opening and closing of stomata.

Practice Questions

1. _____ is a naturally occurring substance secreted by specialized cells that affects the metabolism or behaviour of other cells.
   a) Pancrease
   b) Hormones
   c) Postaglandin
   d) Testes
2. _____ promotes cell elongation
   a) Auxin
   b) Gibberellin
   c) Cytokinin
   d) Resin
3. _____ triggers the absorption of glucose from the blood into cells, where it is added to glycogen molecules for storage.
   a) Testes
   b) Insulin
   c) Adrenalin
   d) Oestrogen
4. _____ are growth inhibitors and induces dormancy, ageing and abscission
   a) Auxin
   b) Gibberellin
   c) Cytokinin
   d) Abscissic Acid
5. The gonads in the female and male are _____ respectively
   a) Testes and Oestrogen
   b) Oestrogen and Testes
   c) Ovaries and Testes
   d) Scrotum and Ovaries
6. _____ stimulates both the release of milk from nipples and contraction of uterus during birth
   a) Oxytocin
   b) Prolactin

c) Lactate
d) Luteinizing hormone

7. There are two types of cells within the pancreas called ____
   a) alpha and omega cells
   b) beta and gamma cells
   c) alpha and beta cells
   d) alpha and gamma cells
8. The growth hormone is located in the ____ gland
   a) Thyroid
   b) Growth
   c) Pituitary
   d) Hypothalamus
9. Antidiuretic hormone (ADH) prevents _____ loss in the body by increasing the re-uptake of water in the kidneys and reducing blood flow to sweat glands.
   a) sweat
   b) urine
   c) saliva
   d) water
10. ____ promotes cell division and inhibits ageing of leaf
    a) Auxin
    b) Cytokinin
    c) Gibberellin
    d) Resin

Answers

1. B
2. A
3. B
4. D
5. C
6. A
7. C

8. C
9. D
10. B

WEEK: 3

Biology SS 3 First Term

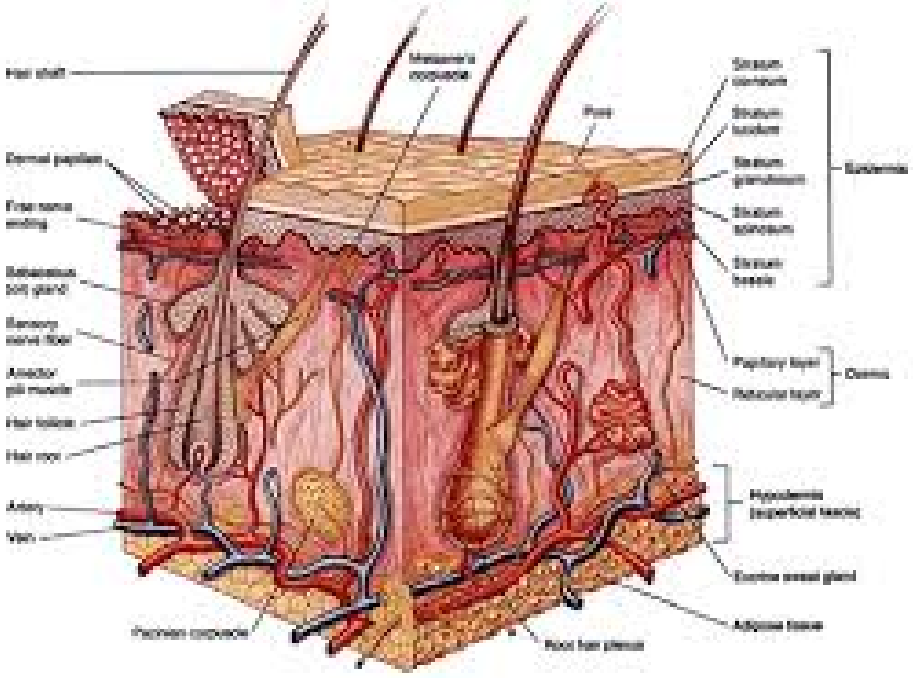
Topic: The Skin

Introduction

The skin is one of the hard working organs in the body. The skin is the outer covering of the body. In humans, it is the largest organ and sense organ. Skin is a thin layer of tissue forming the natural outer covering of the body of a person or an animal. It is the largest organ of the body. The skin protects us from microbes and the elements helps regulate body temperature, and permits the sensations of touch, heat, and cold. The skin's color is created by special cells called melanocytes, which produce the pigment melanin. Melanocytes are located in the epidermis. The skin is made up of two main layers namely:

1. **The Dermis:** This is the inner layer also known as the "true skin". It is directly under the outer layer. Inside the true skin, you will find other structures like the oil gland (sebaceous gland), sweat gland, sweat duct, fat deposit e.t.c
2. **The Epidermis:** This is the outer layer. It has no blood vessels or nerves. It is covered with hair and tiny holes called "seat pores"

Structure of the Skin



The mammalian skin consists of two main layers: the epidermis, and the dermis.

Epidermis: is the outermost layer of the skin. It provides a waterproof barrier and creates our skin tone. The epidermis consists of three layers:

- The innermost Malpighian layer
- The middle Granular layer, and
- The outermost (surface) Cornified layer.

Malpighian layer: Also known as germinative layer. It consists of actively dividing cuboidal cells. They contain melanin, a pigment that gives the skin its colour and absorbs ultra violet radiation. The cells of this layer get their nutrients and supply of oxygen by diffusion from the blood of the capillaries found in the dermis.

Granular Layer: This consists of living cells produced by the malpighian (germinative) layer beneath. These cells are continuously converted to cornified cells. Keratin is deposited inside them, and they lose their nuclei and become flattened in shape.

Cornified Layer: This consists of scale-like dead cells impregnated with keratin. The keratin makes this layer tough, flexible and waterproof. They are constantly wearing away and are replaced from the granular layer beneath.

Dermis: This is beneath the epidermis. It is a layer of connective tissue containing blood capillaries, hair follicles, sweat glands, sebaceous gland, sensory nerve ending and fat cells.

Blood capillaries: This supplies food and oxygen to the dermal and epidermal cells and remove wastes. The capillary loops close to the body surface help to regulate the body temperature.

Hair Follicles: This is a deep pit formed by the in-folding of the Malpighian layer. Each hair is a cylinder composed of dead cells; grow as new cells at the ‘root’. A hair

erector muscle is attached to each follicle. Its contraction pulls the hair to a more upright position, i.e. it makes the hair 'stand up'.

Sebaceous gland: Secretes sebum which repels water (waterproof) and also prevents microbes from multiplying.

Sweat gland: Absorbs fluid from the surrounding tissues and capillaries. This fluid is then passed out as sweat through the sweat duct. Sweat is 99% water, 0.3% salt, and minute amounts of urea and lactic acid.
Sensory nerve ending: The skin is also a sense organ. Various nerve endings, capable of responding to touch, heat, cold and pressure.
Subcutaneous fat: It is found beneath the dermis. It acts as a food reserve and an insulating layer, to prevent heat loss.

FUNCTIONS OF THE SKIN

1. It keeps the body warm in cold weather
2. It helps the body to get rid of waste products through sweating
3. It protects the body against dehydration, invading microbes, mechanical damage and damage due to ultra violet rays and poisonous chemicals.
4. It contains receptors sensitive to heat, cold, touch and pressure.
5. It plays a major role in temperature control (vasodilation and vasoconstriction).
6. It has a minor role as an excretory organ. Urea and lactic acid are lost.
7. The skin produces vitamin D in the fatty cells by using infra-red rays of the sun
8. It helps to keep the body temperature normal by producing sweat during hot weather
9. It protects the body from bacterial infections (germs) poor weather and injury
10. When the sun shines on the skin, vitamin D is produced by the skin
11. **Sensation**: contains a variety of nerve endings that react to heat and cold, touch, pressure, vibration, and tissue injury.
12. **Heat regulation**: the skin contains a blood supply far greater than its requirements which allows precise control of energy loss by radiation, convection and conduction. Dilated blood vessels increase perfusion and

heatloss, while constricted vessels greatly reduce cutaneous blood flow and conserve heat.

13. **Control of evaporation**: The skin provides a relatively dry and semi-impermeable barrier to fluid loss. Loss of this function contributes to the massive fluid loss in burns.
14. **Storage and synthesis**: Acts as a storage center for lipids and water, as well as a means of synthesis of vitamin D.
15. **Excretion**: Sweat contains urea, however its concentration is 1/130th that of urine, hence excretion by sweating is at most a secondary function to temperature regulation.
16. **Water resistance**: The skin acts as a water resistant barrier so essential nutrients aren't washed out of the body.

TYPES OF SKIN

It very important to know our skin type. This helps us to know how to care for them properly. Below are types of skin

1. **Normal skin**: It is soft, clear, smooth and without spots or blemish.
2. **Oily skin**: This is greasy and occur when the oil glands produce too much oil.
3. **Dry skin**: This kind of skin is usually thin, sensitive and have wrinkles easily especially around the mouth and eyes. This can result from poor feeding, ill health, dry weather and lack of care.
4. **Combination (oily and dry skins)**: Has some part of the skin oily i.e. the nose and forehead. While other parts are dry i.e. cheeks

CARE OF THE SKIN

It is necessary to keep the skin clean by having regular bath. In order to care for the skin, it is important to:

1. Wash your whole body daily more than once during hot, dry and dusty season
2. Have a shower after serious exercise or games to avoid body odor
3. Keep your towel, under wears and other clothes clean
4. Use good toilet soap and sponge

5. Take abundant fresh air
6. Do not use bleaching cream
7. Eat balanced diet that is rich in milk, proteins, fruits, cold-liver oil, vegetable e.t.c

RESULTS OF NEGLIGENCE OF THE SKIN

If the skin is left to remain dirty, the following will result:

1. Air will not pass into the body through the skin
2. The sweat pores will be blocked
3. Bad odour and different kinds of skin problems will occur e.g. pimples, irritation e.t.c

COMMON SKIN DISEASES

Below are some common skin diseases which might result to the skin problems due to lack of are:

1. Ringworm
2. Pimples
3. Scabies
4. Eczema
5. Chicken pox or Measles
6. Diaper Rash
7. Heat Rash
8. Boil

SKIN INJURIES

1. Bruises: These result when the body is given a blow with sufficient force. There is bleeding under the skin without breaking it. Swelling and discoloration of the injured area occur

Treatment: Place a clean piece of cloth or handkerchief soaked in very cold water, over the bruised area.

2. Stings: They are bites from insect such as wasp, bee and scorpion. The sting may some times remain in the skin and should be removed.
3. Cuts: These occur whenever the skin is opened, torn or punctured by a sharp object like knives, broken bottles and glasses, scissors or any rough edge.

Treatment: Wash with anti septic solution i.e. clean water into which some drops of antiseptic e.g. addition of dettol

4. Burns and Scalds: these are skin injuries caused by heat. Burns are caused by dry heat or boiling liquids on the skin

Treatment: (i) Cover the burnt or scalded area immediately with cold water (ii) cover the area with Vaseline petroleum jelly and place a layer of gauge over it

CONTROL OF BODY TEMPERATURE

Under normal conditions, the heat the body gain is balanced by the heat it loses. The balance, however, can be upset by hot weather, vigorous exercise, high fever or exposure to solar radiation. The balance is restored by the actions of the hypothalamus and the skin.

- A rise in body temperature stimulates the following processes to get rid of excess body heat:

1. **Vasodilation**: The arteriole in the skin (swell) increases the flow of blood through the skin. This leads to increased loss of heat through the dermis by convection and radiation.
2. **Sweating**: The sweat glands become active and produce large amounts of sweat that flow out onto the surface of the skin. As this sweat evaporates, heat from the body is used up, thus cooling the body. A fall in body temperature stimulates the following processes to produce and conserve heat:

1. **Vasoconstriction**: The arterioles are narrowed, thereby reducing the flow of blood to the skin and so minimizing heat loss.
2. **Sweating**: The sweat glands become inactive and produce very little sweat that flows out to the skin surface, thereby conserving body heat.

NERVOUS CO-ORDINATION

The behavior of an animal in its environment to maintain itself depends on the coordination of its organ systems. Without co-ordination of various organ systems, various physiological processes would work in a haphazard way, without linking together activities. The linking together in time and space of various activities of an animal is called co-ordination. Co-ordination is brought about by the nervous system and sense organs, and by means of chemical substances (hormones) secreted by the endocrine glands.

The most fundamental function of a nervous system is (1) to receive a stimulus (2) transmission of a stimulus to a central "brain", (3) interpretation and analysis of the stimulus and (4) proper response by an effector.

THE HUMAN NERVOUS SYSTEM

The human nervous system is divided into two interrelated parts:

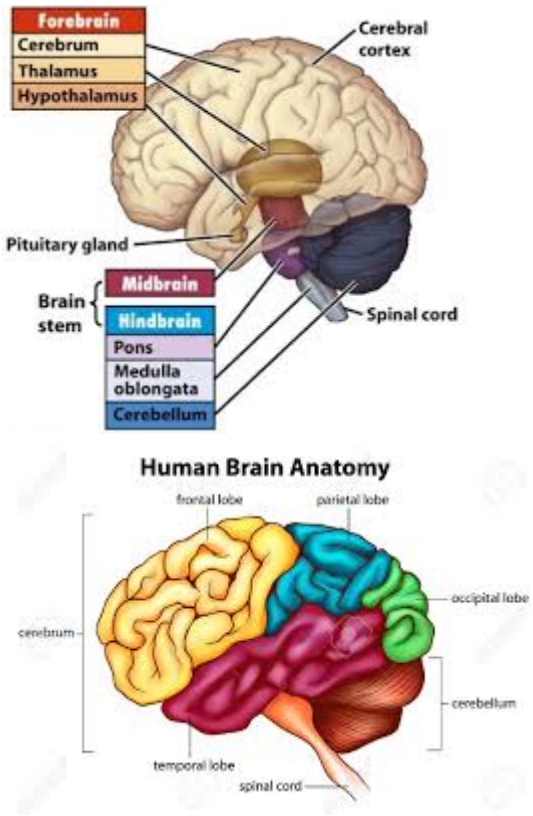
1. The central nervous system (brain and spinal cord).
2. The peripheral nervous system (nerves and ganglia).

CENTRAL NERVOUS SYSTEM

Brain: The human brain is the central information processing organ of our body, and acts as the 'command and control system'. It weighs about 1.5kg (average 1350 gms or 3 pounds) and is enclosed in the cranial (skull) cavity. It is covered by 3 membranes, called meninges. The outer membrane, called dura mater ("tough mother") is a tough, protective covering formed of white fibrous tissue the middle delicate membrane is called arachnoid (web like), and the inner most transparent membrane is called pia mater ("soft mother"), containing blood vessels (nutritive in function). Between the bony and membranous coverings, there is cerebrospinal fluid, which acts as a protective internal cushion. The bony skull, meninges and the cerebrospinal fluid protect the brain from external injury and shocks.

The brain can be divided into three major parts:

(i) Forebrain, (ii) Midbrain, and (iii) Hindbrain



Human Brain

Forebrain

The forebrain consists of cerebrum, thalamus and hypothalamus. Cerebrum forms the major part of the human brain. A deep cleft divides the cerebrum longitudinally into two halves, which are termed as the left and right cerebral hemispheres. The hemispheres are connected by a tract of nerve fibres called corpus callosum. Each hemisphere consists of a frontal lobe, parital lobe, occipital lobe and temporal lobe. The layer of cells which covers the cerebral hemisphere is called cerebral cortex and is referred to as the grey matter due to its greyish appearance.

It is involved in the regulation of sexual behaviour, expression of emotional reactions (e.g., excitement, pleasure, rage and fear), and motivation. The cerebrum wraps around a structure called thalamus, which is a major coordinating centre for sensory and motor signaling. Another very important part of the brain called hypothalamus lies at the base of the thalamus. The hypothalamus contains a number of centres which control body temperature,

urge for eating and drinking. It also contains several groups of neurosecretory cells, which secrete hormones called hypothalamic hormones.

Midbrain

It is known to connect forebrain to other parts of brain and spinal cord.

Hindbrain

The hindbrain comprises pons, cerebellum and medulla (also called the medulla oblongata). Pons consists of fibre tracts that interconnect different regions of the brain. Cerebellum is for balance and muscular control and medulla oblongata controls heart beat, breathing and digestion.

Pratice Questions

1. ____ is known as the true skin.
   a) Dermis
   b) Epidermis
   c) Outer dermis
   d) None of the above
2. The cerebellum can be found in the _____
   a) Fore brain
   b) Hypothalamus
   c) Hind brain
3. _____ consists of scale-like dead cells impregnated with keratin
   a) Granular layer
   b) Cornified layer
   c) Malphigian layer
   d) Hairy layer
4. When you neglect your skin, all of the following happens except ____
   a) Air will not pass into the body through the skin
   b) The sweat pores will be blocked
   c) Bad odour and different kinds of skin problems will occur
   d) The skin will be fresh and clean
5. The human brain is divided into ____ parts
   a) 4

b) 3
c) 2
d) 5

6. The brain and spinal cord can be found in the _____ system
   a) central nervous
   b) peripheral nervous
   c) coordinating nervous
   d) a & b
7. Burns, Stings and Cuts are all types of _____ Injuries
8. ____ secretes sebum which repels water from the skin

Answers

1. A
2. C
3. B
4. D
5. B
6. A
7. Skin
8. Sebaceous Gland

WEEK: 4

Biology, SS 3, First Term,
Topic: The Spinal Cord

Introduction

The Spinal cord is a cylindrical shaped bundle of nerve fibers that is connected to the brain. The spinal cord runs down the center of the protective spinal column (vertebra) extending from the neck to the lower back. The spinal cord contains grey matter in the centre surrounded by white matter. It nerves transmit information from body organs and external stimuli to the brain and send information from the brain to other areas of the body.

Functions of Spinal Cord

1. It carries impulse to the brain
2. It controls reflex action

Peripheral Nervous System

The peripheral nervous system (PNS) is the division of the nervous system containing all the nerves that lay outside of the central nervous system (CNS), that is, the PNS consists of all other nerves and neurons that do not lie within the CNS. The peripheral nervous system is divided into two, the somatic nervous system and the autonomic nervous system.

There are two types of cells in the peripheral nervous system, these include:

Sensory nervous cell: sends information to the CNS from internal organs or from external stimuli.

Motor nervous cells: carries information from the CNS to organs, muscles, and glands.

Peripheral Nervous System Divisions

The peripheral nervous system is divided into the following sections:

- Somatic Nervous System – controls skeletal muscle as well as external sensory organs.
- Autonomic Nervous System – controls involuntary muscles, such as smooth and cardiac muscle. This is further divided into two;
- Sympathetic – controls activities that increase energy expenditures.
- Parasympathetic – controls activities that conserve energy expenditures.

The somatic nervous system: The somatic nervous system is responsible for coordinating the body's movements, and also for receiving external stimuli. It is the system that regulates activities that are under conscious control.This system is said to be voluntary because the responses can be controlled consciously. Reflex reactions of skeletal muscle however are an exception. These are involuntary reactions to external stimuli.

The autonomic nervous system: This controls involuntary muscles, such as smooth and cardiac muscle. This system is also called the involuntary nervous system. The autonomic nervous system can further be divided into the parasympathetic and sympathetic divisions.

The sympathetic nervous system: responds to impending danger or stress (the flight or fight response), and is responsible for the increase of one's heartbeat and blood pressure, dilate pupils, relax the bladder and the sense of excitement one feels due to the increase of adrenaline in the system.

The parasympathetic nervous system: on the other hand, is evident when a person is resting and feels relaxed, and is responsible for the constriction of the pupil, the slowing of the heart, the dilation of the blood vessels, contracting the bladder and the stimulation of the digestive and genitourinary systems. The nerves of the sympathetic division often have an opposite effect when they are located within the same organs as parasympathetic nerves.

Differences between the Somatic and the Autonomic Nervous Systems

	Somatic Nervous System	Autonomic Nervous System
1)	Impulses speed along motor fibres that extend from CNS to effectors without synapses	Impulses speed along motor fibres that extend from CNS to where they synapse.
2)	It affects skeletal muscles.	It affects glands, cardiac muscles and smooth muscles.
3)	It always stimulates effectors.	It may stimulate or inhibit effectors.
4)	Body activities are mainly voluntary.	Activities are mainly involuntary.

Peripheral Nervous System Connections

Peripheral nervous system connections with various organs and structures of the body are established through cranial nerves and spinal nerves. There are 12 pairs of cranial nerves in the brain that establish connections in the head and upper body, while 31 pairs of spinal nerves do the same for the rest of the body. While some cranial nerves contain only sensory neurons, most cranial nerves and all spinal nerves contain both motor and sensory neurons.

The Neurone or Nerve Cell

The nerve cell or neurone is defined as the basic unit of nervous system which is responsible for the transmission of impulses within the body.

The brain is what it is because of the structural and functional properties of interconnected neurones. The mammalian brain contains between 100 million and 100 billion neurones, depending on the species. Each mammalian neurone consists of a cell body, dendrites, and an axon.

Structure of a Neurone

The neurone has a cell body (Soma) which contains the nucleus and cytoplasm. The axon extends from the cell body and often gives rise to many smaller branches before ending at nerve terminals.

Dendrites extend from the neurone cell body and receive messages from other neurons. Synapses are the contact points where one neuron communicates with

another. The dendrites are covered with synapses formed by the ends of axons from other neurones.

When neurones receive or send messages, they transmit electrical impulses along their axons. Many axons are covered with a layered myelin sheath, which accelerates the transmission of electrical signals along the axon. This sheath is made by specialized cells called glia. In the brain, the glia that make the sheath are called oligodendrocytes, and in the peripheral nervous system, they are known as Schwann cells.

The brain contains at least ten times more glia than neurones. The glia(Neuroglia) performs many jobs. Researchers have known for a while that glia transport nutrients to neurones, clean up brain debris, digest parts of dead neurons, and help hold neurons in place.

There are several differences between axons and dendrites:

	Axon	Dendrites
1.	Take information away from the cell body.	Bring information to the cell body.
2.	Smooth surface.	Rough surface (dentritic spines)
3.	Generally only 1 axon per cell.	Usually many dendrites per cell.
4.	No ribosomes.	Have ribosomes.
5.	Can have myelin.	No myelin insulation.

Different Types Of Neurones

There are different types of neurones. They all carry electro-chemical nerve signals, but differ in structure (the number of processes, or axons, emanating from the cell body) and are found in different parts of the body.

- Sensory neurones or bipolar neurones carry messages from the body's sense receptors (eyes, ears, etc.) to the CNS. These neurones have two processes. Sensory neurone account for 0.9% of all neurones. (Examples are retinal cells, olfactory epithelium cells.)
- Motor neurones or multipolar neurones carry signals from the CNS to the muscles and glands. These neurones have many processes originating from the

cell body. Motor neurones account for 9% of all neurones. (Examples are spinal motor neurones, pyramidal neurones.)

- Intermediate neurones or Pseudopolar (Spelling) cells form all the neural wiring within the CNS. These have two axons (instead of an axon and a dendrite). One axon communicates with the spinal cord; one with either the skin or muscle. These neurones have two processes. (Examples are dorsal root ganglia cells.)

The Transmission of Nerve Impulses

Nerve impulses have a domino effect. Each neuron receives an impulse and must pass it on to the next neurone and make sure the correct impulse continues on its path. Through a chain of chemical events, the dendrites (part of a neurone) pick up an impulse that's shuttled through the axon and transmitted to the next neurone. The entire impulse passes through a neurone in about seven milliseconds — faster than a lightning strike. Here's what happens in just four easy steps:

1. Polarization of the neurone's membrane: Sodium is on the outside, and potassium is on the inside. Cell membranes surround neurones just as any other cell in the body has a membrane. When a neurone is not stimulated — it's just sitting with no impulse to carry or transmit — its membrane is polarized, not paralyzed. A polarized membrane means that the electrical charge on the outside of the membrane is positive while the electrical charge on the inside of the membrane is negative. The outside of the cell contains excess sodium ions (Na+); the inside of the cell contains excess potassium ions (K+). (Ions are atoms of an element with a positive or negative charge.)
2. Resting potential gives the neuron a break: When the neuron is inactive and polarized, it's said to be at its resting potential. It remains this way until a stimulus comes along.
3. Action potential: Sodium ions move inside the membrane. When a stimulus reaches a resting neurone, the gated ion channels on the resting neurone's membrane open suddenly and allow the Na+ that was on the outside of the membrane to go rushing into the cell. As this happens, the neurone goes from being polarized to being depolarized. When the neurone was polarized, the outside of the membrane was positive, and the inside of the membrane was

negative. Well, after more positive ions go charging inside the membrane, the inside becomes positive, as well; polarization is removed and the threshold is reached. Each neurone has a threshold level — the point at which there's no holding back. After the stimulus goes above the threshold level, more gated ion channels open and allow more Na+ inside the cell. This causes complete depolarization of the neurone and an action potential is created. In this state, the neurone continues to open Na+ channels all along the membrane. When this occurs, it's an all-or-none phenomenon. "All-or-none" means that if a stimulus doesn't exceed the threshold level and cause all the gates to open, no action potential results. However, after the threshold is crossed, there's no turning back. Complete depolarization occurs and the stimulus will be transmitted. When an impulse travels down an axon covered by a myelin sheath, the impulse must move between the uninsulated gaps called nodes of Ranvier that exist between each Schwann cell.

4. Repolarization: Potassium ions move outside, and sodium ions stay inside the membrane. After the inside of the cell becomes flooded with Na+, the gated ion channels on the inside of the membrane open to allow the K+ to move to the outside of the membrane. With K+ moving to the outside, the membrane's repolarization restores electrical balance, although it's opposite of the initial polarized membrane that had Na+ on the outside and K+ on the inside. Just after the K+ gates open, the Na+ gates close; otherwise, the membrane couldn't repolarize.

Functions of Neurones

1. The nerves conduct impulses to the brain (i.e. sensory neurone).
2. The nerves, e.g. motor neuron.

Practice Questions

1. The peripheral nervous system is divided into two, the somatic and the ____ nervous system

a. automatic
b. autonomic
c. synthetic
d. parasynthetic

2. In repolarization, ___ ions move outside, and _____ ions stay inside the membrane
   a. Potassium, Sodium
   b. Sodium, Potassium
   c. Sodium, Chlorine
   d Potassium, Iodine
3. One of this is not a type of Neurone
   a. Sensory
   b. Motor
   c. Intermediate
   d. Polar
4. The _____ is a cylindrical shaped bundle of nerve fibers that is connected to the brain
   a. Nervous system
   b. Spinal cord
   c. Brain
   d. Neurone
5. The _____ controls involuntary muscles, such as smooth and cardiac muscle.
   a. Somatic Nervous system
   b. Sympathetic Nervous System
   c. Autonomic Nervous System
   d. Neurone

Answers

1. B
2. A
3. D
4. B

5. C

WEEK 6

Biology SS 3 First Term

Topic: Ecology Of Population

Introduction

The term "ecological succession" refers to the progression an ecosystem follows as it changes over time. Scientists refer to individual stages of an ecosystem's growth as "seral stages," and they refer to the entire process of succession as a "sere." Biological succession is a natural process that occurs in all of Earth's ecosystems. Is the gradual replacement of the community of organisms in one area or another, it may take millions of years. In other words, succession is the process by which communities colonise an ecosystem and are then replaced over time by other communities.

Pioneer species to climax communities

Pioneer species: These are the first species to occupy a new habitat, starting new communities. They have rapid reproductive strategies, enabling them to quickly occupy an uninhabited area. Many have an asexual stage to their reproduction.

The first seral stage in any instance of biological succession is called a "pioneer community." In general, pioneer communities are harsh environments that support relatively little flora and fauna. A field, for instance, has only the ground level and underground level at which to support animal and plant life. There is little shelter from the sun, wind and rain.

Seres: These are the various stages that follow on from the pioneer species.

Climax community: This is the stable community that is reached, beyond which, no further succession occurs.

The last seral stage in a process of biological succession is called a "climax community." Climax communities are much more stable environments than pioneer communities, and they support a much wider array of plant and animal life. A fully grown forest, for instance, has many more habitats for animals than a field does. Many types of birds can nest in the trees, as can animals such as squirrels and

chipmunks. Forests provide more shelter from the elements, and they provide habitats for larger animal species as well.

Types of Succession

Primary succession

Biologists use the term “primary succession” to refer to the first time an area develops from bare rock into a fully developed ecosystem. The first step in an instance of primary succession involves lichens and physical weathering processes that break stone into soil. Only when soil is present can vegetation begin to grow in any quantity. Because the breaking down of rock into soil occurs so slowly, primary succession can take thousands of years.

This occurs when the starting point is a bare ecosystem, (e.g, following a volcanic eruption or a landslide). The pioneer species are usually lichen, moss or algae. They are able to penetrate the bare surface, trap organic material and begin to form humus.

Over several generations soil begins to form. The soil can be used by a more diverse range of plants with deeper root systems. Gradually larger and larger plants occupy the ecosystem along with a diversity of animals.

Finally a climax community is reached and the species present do not change unless the environment changes in some way.

An example of primary succession forming an oak woodland:

1. Bare rock is colonised by mosses and lichen.
2. Small plants, ferns and grasses take over.
3. Larger plants with deeper roots appear.
4. Bushes and shrubs replace non-woody plants.
5. Fast growing trees form a dense, low wood.
6. Larger, slow growing oak trees create the oak woodland.

Secondary succession

Secondary succession refers to an instance of biological succession that occurs in an area where primary succession has already taken place and soil is already

established. Normally, secondary succession happens when an ecosystem has suffered some catastrophe, such as a forest fire or a volcanic eruption.
Secondary succession also occurs when an area has been ruined by human activities, such as clear-cutting and slash-and-burn agriculture. Because soil is already established, the process of secondary succession can be completed much more quickly than primary succession.
This occurs when the starting point is bare, existing soil, (e.g, following a fire, flood or human intervention). This type of succession proceeds in the same way as primary succession except that the pioneer species tend to be grasses and fast growing plants.
An example of secondary succession forming an oak woodland:

1. Bare soil is colonised by grasses and pioneer plants.
2. Grasses begin to predominate with time.
3. Shrubs replace the grasses.
4. Fast growing trees appear.
5. Slow growing oaks create the climax community.

Overcrowding

Overcrowding is defined as a situation which occurs when a population in a given habitat increase beyond a point where the resources in the habitat such as space and food are not enough to support all the individuals in the population.
In other words, overcrowding occurs where there is an increase in the population of a particular species beyond the carrying capacity of a particular area. This reduces the space available for each individual species in the population. For example, a space designed to accommodate only five rats can be said to be overcrowded if ten or more of the rats have to live in the place.

Population

Population is defined as the total number of organisms of the same species living together in a given area at a particular time.
In an ecosystem, the community is made up of many populations of different species

Population Density

Population density is defined as the number of individual organisms per unit area or volume of the habitat. Mathematically, population density is expressed as:

Total population or population size/ Area of habitat

Population density can be used to estimate the total number of individual species of a population or population size.

Mathematically:

Population size = population density x area of habitat

Factors that May cause Overcrowding

The following factors may be responsible for overcrowding:

- **Increase in birth rate (Natality):** When there is an increase in the rate at which a particular species gives birth in a restricted area, overcrowding will definitely take place
- **Increase in food supply:** With increase in the supply of food to a particular habitat, there will be a corresponding increase in the population which will later result in overcrowding
- **Decrease in death rate (Mortality):** If the rate at which organisms die in a habitat is very low compared to the rate at which they are being given birth to, the population will not reduce, hence overcrowding will take place
- **Immigration:** The migration or movement of individuals or species into the habitat will increase the population which will later cause overcrowding in the habitat
- **Lack of dispersal:** The fruits or seeds of certain plants fall just under the tree and germinate there. This lack of dispersal causes overcrowding
- **Social habits:** Most social animals such as termites, ants and bees which continues to live and multiply in a colony increase the population until the area is overcrowded
- **Inadequate space:** This occurs if the space occupied by individuals (plants or animals) is such that when compared to their number is small or inadequate
- **Absence of predators:** When predators are absent, the population of some species (prey) can grow to such a level that overcrowding occurs

Effects of Overcrowding

Overcrowding do have effects on the organisms occupying the habitats. The effects of overcrowding include:

• Shortage of space: As a result of increase in the population of species, there would be lack of space for the organism

• Shortage of food: The available food in the habitat is rapidly eaten up due to overcrowding and this eventually results in overcrowding and this eventually results in the shortage of food

• Competition: Due to increase in the population with limited resources such as food and space, individuals have to compete among themselves to get these scarce resources. The stronger ones get these resources while the weaker ones are deprived of them

• Anti-social behaviour: Most animals due to stress as a result of overcrowding resort to fighting or cannibalism

• Spread of diseases: Diseases can easily spread in an overcrowded environment. For instance, tuberculosis in human which is an air-borne disease can easily be spread

• Preying on each other: Animals in overcrowded environment have the tendency to prey or feed on each other especially when food is in short supply

• Death of organisms: Death of some weaker organisms may occur in an overcrowded area as a result of non-availability of food and space. The stronger ones survive while the weaker ones die off.

Adaptations to Avoid Overcrowding

Plants and animals have developed various means to avoid overcrowding. Such means and ways include:

• Territorial behaviour: This is a natural means to avoid overcrowding in animals. some animals especially mammals, lizards, birds etc. establish territories. Territories are resting areas which the animals carve out for themselves. They are usually possessive of these areas. They fight for and defend the territories against intruders or other members of the same species. Their ability to claim the territory successfully ensures that they have sufficient space, food, mating partners and

parental care. The establishment of territories ensure that there is no overcrowding in the area

• Dispersal of seed and fruits: This is also a natural means of avoiding overcrowding in plants. The dispersal of seeds and fruits either by water, wind, animals, insects, explosive mechanism etc. reduces the chances of overcrowding. These seeds and fruits are carried far away from parent plants hence overcrowding is avoided or prevented

• Emigration: Emigration involves the movement of individuals or animals out of their locality to another place for settlement in a new habitat. Such outward movement of animals, even human beings, prevents overcrowding

• Swarming: The swarming of certain social animals such as termites and bees occur when some members of an old colony separate and fly out to establish a new colony. Following this swarming, a new colony begins at a new location, hence overcrowding is avoided

• Production of chemicals by plants: The production of chemicals by roots of some plants sometimes prevent the growth of other plants close to them. This device prevents overcrowding

• Production of canopies: The production of canopies by tall plants helps them to trap enough sunlight and prevent the plants below from getting the light. These lower plants eventually die off and overcrowding is prevented or avoided.

Relationship Between Competition and Succession

Succession is the progressive natural development of vegetation towards climax, during which one community is gradually replaced by others. This replacement might be some form of competition. It stands to reason then that succession can only occur after there has been competition. The weaker organism is succeeded by the stronger one after competing.

Types of Adaptations

There are three major types of adaptation. These are:

1. Structural adaptation
2. Adaptive colouration

3. Behavioural adaptation

Structural Adaptation: A structural adaptation is when an animal or a living thing is adapted to its environment by the way its body is built or shaped. Structural adaptations involve physical traits that can help an organism to survive in its environment. They can be its body shape, body parts, outer covering, colour or unusual life processes.

- Teeth – since different animals eat different things, they don't all have the same kind of teeth
- Body coverings – Hair, scales, spines, and feathers grow from the skin. All of these parts help animals survive in their environments.
- Movement – animals find food by moving from place to place

For example, the frog has webbed feet to help it to escape from its predators quickly and catch its prey faster.

Structural Adaptations for Feeding

Animals have developed distinct anatomical structures diagnostic of the food and the type of feeding they use. For example, the number, size, shape and location of teeth and the movement of the jaw differ in mammals according to the type of food they eat. The beaks of birds are highly specialized for food gathering and provide examples of the great diversity of diets even among related species. Other structures in the head are also involved in successful acquisition of food, such as strength and arrangement of jawbones, size and placement of muscles, and structure of the tongue. Of course, many other traits, such as the ability to hover, chase, or pounce, are integral to animals ability to get food.

Mammalian Teeth

The number and type of teeth an animal has reveals much about its diet and feeding methods. For example, the long canines of a carnivore, like a cougar, are used to bite and tear at prey. A beaver, on the other hand, is herbivorous, lacks canines, and uses its long incisors to strip bark and gnaw wood. Some teeth are rooted, meaning that once they come in, they do not continue to grow. Rooted

teeth wear down with use. In contrast, rootless teeth keep growing throughout an animal's life. For example, the long incisors of the beaver are rootless. Beavers must continue to gnaw or their incisors will grow too long and cause problems, even death.

Four types of teeth are found in mammals. Each type of tooth is adapted to perform a particular function:

1. The incisors: which develop at the front of the jaw, are used for biting and stripping.
2. The canines: located behind the incisors, are generally designed for seizing, piercing, and tearing.
3. The premolars: are behind the canines used for crushing, grinding and shearing.
4. The molars: designed for crushing and grinding.

Not all mammals have all four types of teeth or the same number of each type. The number of different types of teeth an animal has is called its dental formula. Since mammals are bilaterally symmetrical, the same numbers of teeth are located on both the right and left side, so the formula states the number for half of the mouth, upper and lower. For example, the dental formula of a woodchuck is 1/1, 0/0, 2/1, 3/3 – that is, 1 upper incisor/1 lower incisor, no canines, 2 upper premolars/1 lower premolar, 3 upper molars/3 lower molars. The total number of teeth is 22. The dental formula in humans is 2/2, 1/1, 2/2, 3/3. The total number of teeth is 32.

Bird Beaks

There are numerous structural features of bird beaks that vary in adaptation to food and how it is obtained, although the relationship between bill structure and diet is not as predictable as it is for tooth structure in mammals. For example, woodpeckers have long, tough, pointed beaks, along with a very robust skull that allows them to hammer holes in trees in search of food. In general, the thicker the beak, the more appropriate it is for cracking large seeds, but even small, deep beaks are used to crack seeds (for example, the house sparrow). Thin beaks are generally useful for manipulating prey, like caterpillars. Wide beaks are useful for catching flying prey, like mosquitoes. Hooked beaks can be used in a similar way to a

mammal's incisors (biting and stripping), and long slender beaks can be used to gather nectar from flowers, like those seen in hummingbirds. Other variations observed in beaks include serrated edges for holding prey (like fish), or filter-like structures used to strain food particles from water. For example, all raptors are carnivores that feed on other animals. However, each species of raptor occupies a different niche because each one specializes on a particular type or size of prey, relies on a different method of hunting, or hunt in different times of the day. Similarly shorebirds utilizes different depth of water and different types of prey and ducks can be either be herbivores, omnivores or carnivores and resulted into different beak structures.

Structural Adaptations for Flight – Wing structure

Wings of birds are modified forelimbs that function as airfoils, that is, convex on top and concave on the bottom so that the air going above the wing moves faster than the air below the wing. This creates an air pressure difference that provides an upward lift. In addition, many birds flap their wings to create lift and thrust for flight. The ability of birds to glide or fly depends on the ratio of the body mass to the surface area of the wings, called wing loading. In addition, the shape of the wing, the relative length, the width of the wing and feather arrangement all have effects on the wing's performance and suitability for different types of flight. Birds have other special features that are important for flight. Their bones are hollow with interior bracing and thus are both light and strong. Active, powerful flyers have skeletal adaptations of a large breastbone with a deep keel for flight muscles to attach. The relative size of this keel is an indicator of the strength of flight.

Adaptations for Defence and Protection

Chameleon uses photosensitive cells on its skin to pick the environment in which it finds itself as a measure of protection from its preys. Some insects have various ways of protecting or defending themselves. Some secrete repelling odours to drive away animals intending to attack them. The bee stings in order to defend itself. Other animals withdraw to their shells e.g. snails and tortoise

Adaptation for Securing Mates

The male peacock has beautiful feathers which it displays for the female so as to attract it before mating. The red-head Agama lizard raises it up and down to attract the female. Insect pollinated flowers are mostly brightly coloured.

Adaptation for Regulating Body Temperature

Mammals maintain a constant body temperature due to the presence of hairs, furs. These they use in trapping air inbetween pores in times of cold weather. That is why people living in temperate regions tend to be more hairy than those in tropics. The cold-blooded ones like fishes adjust using scales to give them the required temperature.

Adaptation for Water Conservation

Xerophytes possess thick cuticle and water reservoirs in their stems, thick backs to withstand loss of water, reduced sizes of leaves, at times thorns in place of leaves, all to reduce the rate of transpiration e.g. Baobab and Acacia. Camels are able to travel long distances in the desert without drinking water for day.

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- **Lack of dispersal:** The fruits or seeds of certain plants fall just under the tree

and germinate there. This lack of dispersal causes overcrowding

• **Social habits:** Most social animals such as termites, ants and bees which continues to live and multiply in a colony increase the population until the area is overcrowded

• **Inadequate space:** This occurs if the space occupied by individuals (plants or animals) is such that when compared to their number is small or inadequate

• **Absence of predators:** When predators are absent, the population of some species (prey) can grow to such a level that overcrowding occurs.

Practice Questions

1. The total number of organisms of the same species living together in a given area at a particular time is ____
   a. Populace
   b. Population
   c. Population size
   d. Population Density
2. _____ is defined as the number of individual organisms per unit area or volume of the habitat.
   a. Populace
   b. Population
   c. Population size
   d. Population Density
3. One of the following is not a type of Adaptation.
   a. Structural adaptation
   b. Adaptive colouration
   c. Behavioural adaptation
   d. Character adaptation
4. _____ involves the movement of individuals or animals out of their locality to another place for settlement in a new habitat
   a. Immigration
   b. Migration

c. Emmigration
d. Movement

5. ____ refers to the birt rate of a population
   a. Natality
   b. Mortality
   c. Carnality
   d. Totality
6. The first set species to occupy a new habitat and start new communities are called _____ species
   a. Pioneer
   b. Initial
   c. Old
   d. None of the above
7. _____ is defined as a situation which occurs when a population in a given habitat increase beyond a point where the resources in the habitat such as space and food are not enough to support all the individuals in the population.
   a. Population
   b. Overcrowding
   c. Succession
   d. Survival of the fittest
8. ____ uses photosensitive cells on its skin to pick the environment in which it finds itself as a measure of protection from its preys.
   a. Bee
   b. Snail
   c. Chameleon
   d. Tortoise
9. Mention 3 factors that may cause overcrowding.
10. _____ is when an animal or a living thing is adapted to its environment by the way its body is built or shaped.
    a. Structural adaptation
    b. Behavioural adaptation
    c. Adaptive colouration
    d. Adaptation

Answers

1. B
2. D
3. D
4. C
5. A
6. A
7. B
8. C
9. Immigration
   Increase in natality rate
   Decrease in mortality rate
   Inadequate space
   Absence of Predators
10. A

WEEK 7

Biology SS 3 First Term

Topic: Territorial Behaviour in Organisms

This is a natural means to avoid overcrowding in animals. some animals especially mammals, lizards, birds etc. establish territories. Territories are resting areas which the animals carve out for themselves. They are usually possessive of these areas. They fight for and defend the territories against intruders or other members of the same species. Their ability to claim the territory successfully ensures that they have sufficient space, food, mating partners and parental care. The establishment of territories ensure that there is no overcrowding in the area

• Dispersal of seed and fruits: This is also a natural means of avoiding overcrowding in plants. The dispersal of seeds and fruits either by water, wind, animals, insects, explosive mechanism etc. reduces the chances of overcrowding. These seeds and fruits are carried far away from parent plants hence overcrowding is avoided or prevented

• Emigration: Emigration involves the movement of individuals or animals out of their locality to another place for settlement in a new habitat. Such outward movement of animals, even human beings, prevents overcrowding

• Swarming: The swarming of certain social animals such as termites and bees occur when some members of an old colony separate and fly out to establish a new colony. Following this swarming, a new colony begins at a new location, hence overcrowding is avoided

• Production of chemicals by plants: The production of chemicals by roots of some plants sometimes prevent the growth of other plants close to them. This device prevents overcrowding

• Production of canopies: The production of canopies by tall plants helps them to trap enough sunlight and prevent the plants below from getting the light. These lower plants eventually die off and overcrowding is prevented or avoided.

Effects of Food Shortage

The scarcity of a particular type of food may create population problems. Such effects of food shortage on the size of population include:

1. **Competition:** When food is scarce, there will be scrambling for available food thereby leading to survival of the fittest in some cases. The individuals may engage in fighting, biting and cannibalism.
2. **Emigration:** If food shortage lasts for a long time, animals or even human beings may migrate from an area of food shortage to places where sufficient food is available.
3. **Decline in the rate of reproduction:** Food shortage can bring about a decline in the rate of reproduction, for example, human beings tend to avoid marriage when they are not sure of how to feed themselves. Again, many engage in family planning so as to raise the number of children which they can easily take care of.
4. **Scarcity of a particular type of food:** This may create population problems especially for herbivores and carnivores which feed directly or indirectly on producers. Absence of producers may lead to the death of these group of organisms. However, the omnivores can survive this condition because it can feed on a wide varieties of food materials.

Dynamic Equilibrium in Nature and Factors that Maintain it

The factors which affect population size include abiotic factors such as temperature, water, space etc and biotic factors such as food, competition, parasite etc. When these factors are favourable, growth is promoted, but when they are scarce or unfavourable, growth is retarded.

A factor which limits population growth is called **limiting factor** and the sum of all limiting factors is known as **environmental resistance.**

The net effect of these abiotic and abiotic factors is that at a point, the population size of living organisms tends towards a dynamic equilibrium known as **balance in nature.** When the population increases, the environmental resistance increases too. This means that when population is on the increase, the available food tends

to decrease. This calls for competition which will later lead to death of the weaker organisms, thereby keeping the population relatively constant.
Human beings are able to control the population by family planning and birth control whereas in nature, biological equilibrium is attained by predator – prey relationship.

Practice Questions

1. _____ involves the movement of individuals or animals out of their locality to another place for settlement in a new habitat.
   a. Immigration
   b. Emigration
   c. Migration
   d. Movement
2. A factor which limits population growth is called ____
   a. unlimiting factor
   b. limiting factor
   c. coordinating factor
   d. biotic factor
3. Human beings are able to control the population by all of the following ways except ____
   a. Family planning
   b. Birth control
   c. Use of contraceptives
   d. Predator – Prey relationship
4. The net effect of these abiotic and abiotic factors is that at a point, the population size of living organisms tends towards a dynamic equilibrium known as _____
   a. balance
   b. equilibrium
   c. balance in nature
   d. succession

5. The abiotic factors which affect population size include all of the following except ____
   a. Competition
   b. Temperature
   c. Water
   d. Space

Answers

1. B
2. B
3. D
4. C
5. A

WEEK: 7

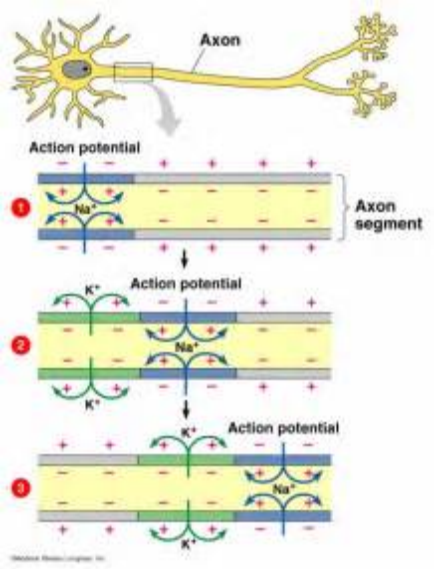
Biology SS 3 First Term

Topic: Reflex and Voluntary Actions

Definition: A reflex action is an involuntary or automatic action in response to impulses initiated by a stimulus. A reflex is something that your body does natural. In other words, reflex action is a rapid or quick response to stimuli which are not consciously controlled by the brain. It is fast, inborn (instinctive) and stereo-typed. A given stimulus always produces the same response.

Characteristics of Reflex Action

1. Reflex action is a response without prior thought or planning.
2. It is not under the control of the control of the will or it is automatic.
3. It is a quick response.
4. It is entirely in stereotyped in nature.
5. It involves minimum member of nerves cells.
6. It terminates at the spinal cord.



Examples of Reflex Actions

1. Blinking of the eyes

2. Jerking of the kneel
3. Salivation
4. Coughing
5. Peristalsis
6. Secretion of glands
7. Beating of the heart

Voluntary Actions

Definition: Voluntary actions are responses to stimuli that are consciously controlled or co-ordinated by the brain. In other words, voluntary actions are actions taken deliberately, involving the exercise of the will or brain.

Characteristics of Voluntary Actions

1. It involves prolonged response.
2. Its response is controlled by the brain.
3. Its response to a particular stimulus may vary.
4. It involves many nerves cells.

Example of voluntary actions

1. Writing
2. Dancing
3. Eating
4. Driving
5. Singing
6. Walking etc.

Differences between Reflex and Voluntary Actions

	Reflex Action	Voluntary Action
1.	Action is initiated by muscle receptor.	Action is initiated in the brain.
2.	It occurs unconsciously.	It occurs consciously.
3.	It is automatic and fast.	It is neither automatic nor fast.

4.	It is inborn.	It can be learnt.
5.	Nerve impulses do not reach the brain.	Nerve impulses always reach the brain.

The Reflex Arc

Reflex reactions in humans are controlled by the reflex arc. When the safety of an organism demands a very quick response, the signals may be passed directly from a sensory neuron, via a relay neurone, to a motor neurone for instant, unthinking action. This is a reflex action.

A reflex arc is a neural pathway that controls an action's reflex, i.e. it is the nerve pathway which makes such a fast, automatic response possible. It does not matter how brainy you are – you will always pull your hand away from a flame without thinking about it. It is an in-built, or innate, behaviour, and we all behave in the same way.

A reflex arc consists of the following parts:

1. Sensory cells: These cells receive the stimulus.
2. Sensory or afferent neurone: This conducts or transmits nerve impulses from the sensory cells to the spinal cord or brain.
3. Intermediate neurone: This conducts nerve impulses from the afferent to the efferent neurone.
4. Motor or efferent neurone: This conducts or transmits impulses from the intermediate neurone to the effector.
5. Effector (muscle or gland): This takes action.

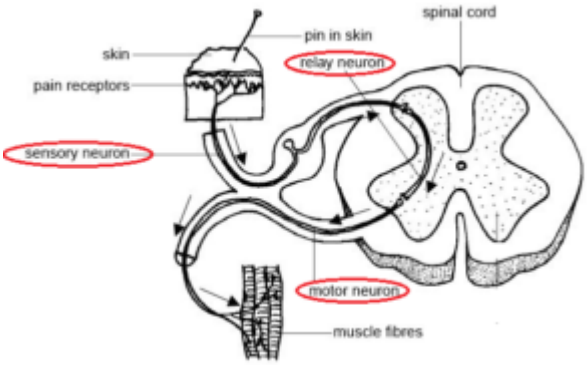
A Simple Reflex Arc

Conditioned Reflex

Conditioned reflex is a learned response or behaviour after birth. Once they are acquired, they can be performed without thinking about them. Most of our behaviours are conditioned reflexes. Examples are walking, driving, reading, writing, swimming etc. It takes a fairly long time to learn each of these skills. But

once they have been mastered, they are performed very fast and efficiently without the individual thinking about them. They become habits.

Behaviour conditioning was first described by a Russian scientist, Ivan Pavlov in 1902 from his experiments on dogs. Naturally, a dog's mouth becomes wet when it is given food due to reflex action. In one experiment, Pavlov rang a bell just before giving the dog its food. After repeating this several times the dog learnt to associate the bell with food. Hence, it salivated as soon as it heard the bell, i.e., before the food appeared. Pavlov called this response a conditioned reflex.



Role of Conditioned Reflex on Behaviour

1. It helps individuals to acquire new skill through the learning of such habits.
2. It helps to develop certain behaviour which are not originally shown in the individual.
3. Unhealthy behaviour like smoking, drinking and drug taking may become bad habits when acquired through conditioned reflex and may be difficult to stop.
4. The principle is used in the training of dogs for their special role in crime detection and for security.

Differences between Reflex Action and Conditioned Reflex

	Reflex Action	Conditioned Reflex
1.	It is an inborn behaviour.	It is a learned behaviour.
2.	It takes a short time.	It takes a longer time.
3.	It involves spinal cord and relayed to brain after action is completed.	It is controlled by the brain.

4.	Action starts by muscle receptor cells.	Action starts in the brain.

Practice Questions

1. A _____ is an involuntary or automatic action in response to impulses initiated by a stimulus
   a) Reflex action
   b) Voluntary action
   c) Conditioned Action
   d) Reflective action
2. A reflex arc consists of the following except ___
   a) Sensory cells
   b) Sensory or afferent neurone
   c) Intermediate neurone
   d) Nerve cells
3. _____ are responses to stimuli that are consciously controlled or co-ordinated by the brain. In other words, voluntary actions are actions
   a) Reflex action
   b) Voluntary action
   c) Conditioned Action
   d) Reflective action
4. ____ is not an example of reflex action
   a) Blinking of the eyes
   b) Jerking of the kneel
   c) Salivation
   d) Prolonged response to a question
5. One of this is an example of voluntary action
   a) Coughing
   b) Peristalsis
   c) Writing
   d) Secretion of glands

Answers

1. A
2. D
3. B
4. D
5. C

WEEK: 8

Biology, SS 3, First Term

Topic: Family Planning/Contraception

Introduction

Family planning is a device by which couples (husband and wife) determine the number of children they want and when they want them.

Birth control on the other hand refers to a method used to prevent a woman from becoming pregnant for as long as she wishes. Many parents decide to have a few number of children so they can afford to cater for their feeding, clothing, housing, education and medical care.

Without family planning, the population of a nation can rise indiscriminately and may not be able to match the available food and other resources, hence famine and death can result.

It is very important to point out that family planning is centred on prevention of pregnancy rather than termination of life (abortion). When family planning is carefully carried out, the issue of unwanted pregnancy is prevented.

Birth Control or Family Planning Devices

Birth control or family planning devices include the following:

1. **Withdrawal method:** By this method, the man pulls his penis out of the woman's vagina before the ejaculation of spermatozoa occurs. This method is not very reliable because some sperm cells may be released without the man knowing.
2. **Rhythm method or safe period:** This involves the calculation of safe periods for each woman. To avoid getting pregnant, a woman should not have sex with a man during the fertile days, i.e., days mid way between her menstrual periods which usually starts ten days after the first day of menstruation. This method is also not reliable as ovulation can take place at irregular intervals.
3. **Use of condom (Sheath):** This is a rubber sheath which the man wears over the penis before sexual intercourse. When he ejaculates spermatozoa, they are

collected within the condom thereby preventing them from entering into the vagina of the female. This works very well in preventing pregnancy and at the same time protecting the man against veneral diseases such as syphilis, gonorrhea and AIDS.

4. **Cap (Diaphragm):** This is a rubber protective cap worn by women. It is inserted into the vagina so as to prevent spermatozoa from entering the uterus and into the fallopian tube where they may bring about fertilisation of the ovum. The diaphragm is best used in combination with spermicidal cream or tablets.
5. **Spermicidal cream or tablet:** A spermicidal cream or tablet is one that kills spermatozoa. A woman applies such a cream or tablet right inside her vagina 5 – 10 minutes before sexual intercourse. During ejaculation by the man, the spermatozoa discharge are killed by the spermaticide, hence pregnancy is prevented. This method is not very reliable except it is used with condom.
6. **Intra-uterine device (IUD):** This may be a metal or plastic coil or loop that is inserted into the uterus of the woman. It is usually done by a doctor. This device prevents fertilization or the implantation of the zygote in the uterus. The intra-uterine device is left in the uterus until it is necessary to replace or remove it. When properly inserted, it is reliable and economical as well.
7. **Contraceptive pill:** This is a tablet which is taken daily by the woman. The pill contains hormones which prevent ovulation or the release of egg from the ovary. The tablet must be prescribed by a qualified doctor. The pill is effective and must be used according to prescription to obtain good result.
8. **Injection:** An injection is usually given to the woman every three to six months intervals. The injection contains hormones which prevent ovulation. Such injection must be given to the woman by a qualified medical doctor because it has some side effects. It is a sure way of family planning and it is very useful to women who have stopped child bearing.
9. **Sterilisation:** Sterilisation is done by couples who do not want more children. It is an irreversible birth control method. In other words, once it is done, one cannot reverse it. It is the surest method. It is done by cutting the sperm duct (spermatic cord) in men (**vasectomy)** and the cutting of the oviduct (**fubal ligation)** in women. This method requires an operation to be done by a qualified medical doctor.

Reproductive System

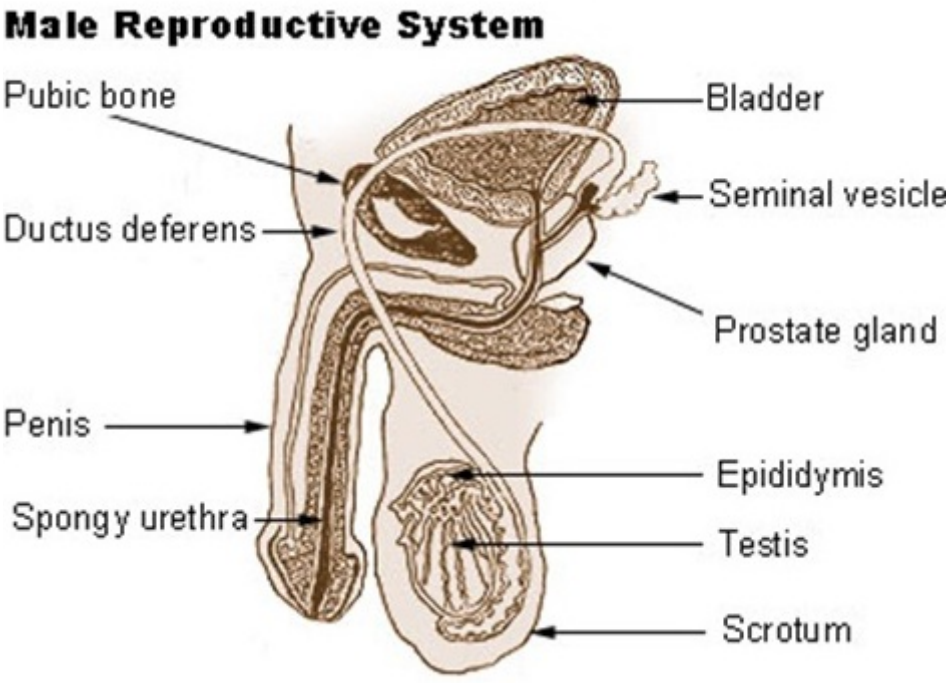
One of the characteristics of living things is their ability to produce young ones of their kind. Any living organism that gives birth to new offspring is said to undergo reproduction. Every living thing reproduces its kind. Human beings also give birth to their young ones, etc. They do this by the process of reproduction.

Reproduction is the process by which living things produce their kinds. Mammals such as human beings reproduce their young ones and take care of them until they become independent. The organs responsible for reproduction make up the reproductive system.

Parts of the Male Reproductive System

The male reproductive organs include:

- Testes
- Penis
- Vas deferens
- Urethra
- Prostate gland, cowper's gland and seminal vesicles



Functions of the Male Reproductive Organ

Testes

These are pairs of oval structures consisting of a mass of coiled seminiferous tubules where sperm cells are produced. The testes are placed in the scrotal sac which hang from the groin. They also produce a hormone known as testosterone that is responsible for bringing out secondary sex characteristics in man.

Penis

This is a rectile organ that is attached and suspended from the base of the abdomen. Its function is to introduce sperm into the vagina. It can alter its size and shape according to the amount of blood flowing through it. It usually stands erect when the male is sexually excited, to enable it to penetrate into the vagina for reproductive purpose.

Vas deferens

This is a tube that connects the epidermis with the urethra. Sperm is stored here.

Urethra

This is a tube that runs down the length of the penis from the urinary bladder through the prostate gland to an opening at the tip of the penis. Sperm travels down the urethra to be ejaculated.

The Prostate gland, Cowper's gland Seminal vesicles

They secrete substances which mix with the sperm to form the semen or seminal fluid. This fluid contains nutrients and other substances that activate the sperm and also provides a transport medium for it.

Generally, the male reproductive organ performs the following functions:

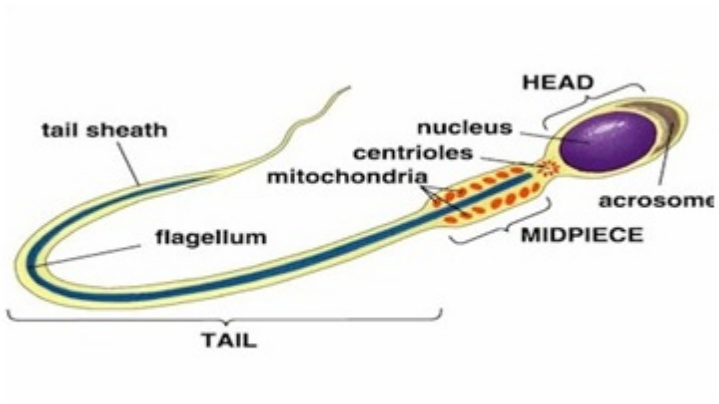
i. Production of male hormones (testosterone).

ii. Production and storage of sperm cells

iii. Introduction of sperm cells into the female reproductive tract to fertilize, the ovum (egg) for the formation of zygote that will grow into an embryo is a product of seminal sperm.

The Male Gamete (Spermatozoon)

The male gamete is called the spermatozoon (sperm). It has a flagellum-like tall. The head is mainly made up of nucleus and becomes motile when activated by fluids from the prostate gland and seminal vesicles.

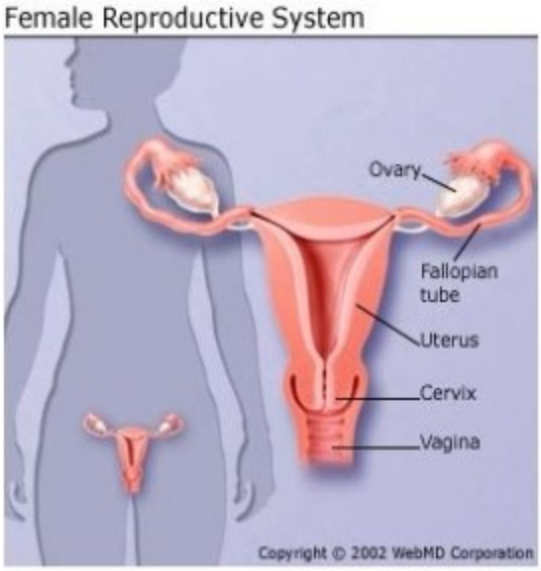


A mature spermatozoon

Parts of the Female Reproductive System

The female reproductive organs are:

- Ovaries
- Fallopian tube
- Uterus
- Vagina
- Vulva



Functions of the Female Reproductive Organs

Ovaries

These are small, paired oval glands that lie on each side of the uterus and are held in place by ligaments. Ovaries release the egg or ovum every month from the onset of puberty. This process is known as ovulation. If the egg is fertilized by a sperm and the fertilized egg sticks to the wall of the uterus (implantation), the female is described as being pregnant at this stage, but if not fertilized, it is discharged or shed along the linning of the uterus as a mixture of mucus and blood in a process known as menstruation.

Fallopian Tube (Oviduct)

This is the tube leading from each ovary to the uterus (womb) through which the released egg passes. The fallopian tube is place where fertilization takes place.

Uterus (Womb)

This is situated in the lower abdomen. It lies behind the bladder and in front of the rectum. It is a hollow, thick-walled, muscular, and oval organ about 8cm long, and 5cm wide. The development of the foetus takes place in the uterus before delivery.

Vagina

This is an elastic muscular canal leading from the lower end of the uterus to the outside of the body. It is 9-13cm long. It is the copulatory organ of the female and also functions to receive sperm and as canal for birth. The opening of the vagina is partly covered by a membrane known as hymen. The vagina being very elastic stretches in order to allow easy passage of the baby during labour.

Vulva

This is the external part of the female reproductive organ which consists of the labia majora, labia minora and the clitoris which is an erectile organ like the penis. It becomes erect when the female is sexually stimulated.

Generally, the functions of the female reproductive organs are:

i. For fertilization

ii. For the production of the female reproductive cell (Ova)

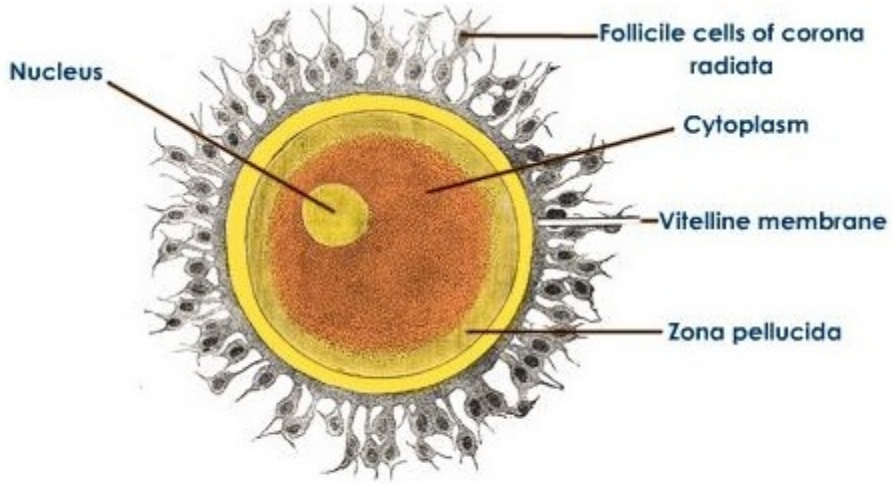
iii. For feeding, nurturing and protecting the developing foetus

iv. For the production of the female sex hormones- oestrogen and progesterone that maintain the female monthly cycle

v. For pushing the baby out of the womb during delivery.

The Female Gamete (Ovum)

The female gamete is the ovum, (plural: oval) or the egg cell. It is large and spherical with a central nucleus and cytoplasm. These ova are produced in the ovaries. It is released by the ovary when the age of puberty is reached once every month. It contains yolk and nutrients



An Ovum

Sex cells

The reproductive sex cells are also known as gametes. The formation of gametes called gametogenesis takes place in the gonads (Testes and Ovaries).

Male gametes or Sex cells called sperms are produced in the testes by a process called spermatogenesis. The gamete is unicellular in nature. The gamete (sperm or egg) from each parent fuses (combines) during a process called fertilization to produce DNA replication and the creation of a single-celled zygote which includes genetic material from both gametes.

In a process called genetic recombination, genetic material (DNA) joins up so that homologous chromosome sequences are aligned with each other, and this is followed by exchange of genetic information. Two rounds of cell division then produce four daughter cells with half the number of chromosomes from each original parent cell, and the same number of chromosomes as both parents, though self-fertilization can occur. For instance, in human reproduction each human cell contains 46 chromosomes, 23 pairs, except gamete cells, which only contain 23 chromosomes, so the child will have 23 chromosomes from each parent genetically recombined into 23 pairs. Cell division initiates the development of a new individual organism in multicellular organisms, including animals and plants, for the vast majority of whom this is the primary method of reproduction

Practice Questions

1. ____ is a device by which couples (husband and wife) determine the number of children they want and when they want them.
   a. Birth control
   b. Family planning
   c. Withdrawal method
   d. Contraceptive method
2. The reproductive sex cells are also known as ___
   a. gametes
   b. zygote
   c. ovaries
   d. testes
3. Male gametes cells are produced in the testes by a process called _____
   a. gametogenesis
   b. oogenesis
   c. spermatogenesis
   d. none of the above
4. ____ is a tube that runs down the length of the penis from the urinary bladder through the prostate gland to an opening at the tip of the penis.
   a. Urethra
   b. Ureter
   c. Fallopian tube
   d. Vas deferens
5. _____ is the tube leading from each ovary to the uterus (womb) through which the released egg passes.
   a. Urethra
   b. Ureter
   c. Fallopian tube
   d. Vas deferens
6. The gamete (sperm or egg) from each parent fuses (combines) during a process called _____ to produce DNA replication and the creation of a single-celled zygote which includes genetic material from both gametes.

a. Self fertilization
b. Fertilization
c. Gametogenesis
d. Homogenuity

7. One of the following is not a female sex hormone
   a. Oestrogen
   b. Progesterone
   c. Ovaries
   d. Testosterone

Answers

1. B
2. A
3. C
4. A
5. C
6. B
7. D

WEEK: 9

Biology, SS 3, First Term

Topic: Development Of New Seeds

Introduction

The flower is the reproductive structure in flowering plants. There are two modes of plant reproduction: asexual reproduction and sexual reproduction. Sexual reproduction in plants consists of alternating, multicellular haploid and diploid generations. In angiosperms, the female gametophyte is the embryo sac and the male gametophyte is the pollen. The haploid egg and sperm fuse to form diploid zygotes, from which new sporophytes develop. Fertilization inside the flower often leads to the production of seeds which are capable of germinating into new plants. In asexual reproduction, offspring are produced without meiosis or fusion of gametes and the plant multiplies through tubers, bulbs, corms and other vegetative parts.

The Structure of a Flower

Flowers play a key role in pollination. Pollination is the transfer of pollen (containing the male gametes), from the anther of a flower, to the stigma (receptive surface of the female part of the flower) of the same or a different flower.

Parts of the Flower

The flower is made up of four floral parts. These are the calyx, the corolla, the androecium and gynoecium.

Carpel – it is collectively known as the gymnoecium which is made up Central female organ of the flower. It is generally bowling-pin shaped and located in the center of the flower. A separate carpel or a single structure of several fused carpel is called a pistil. The pistils have the followings:

·Stigma – Receives pollen, typically flattened and sticky

·Style – Connective tissues between stigma and ovary

·Ovary – Contains ovules or embryo sacs

·Ovules – Unfertilized, immature seeds

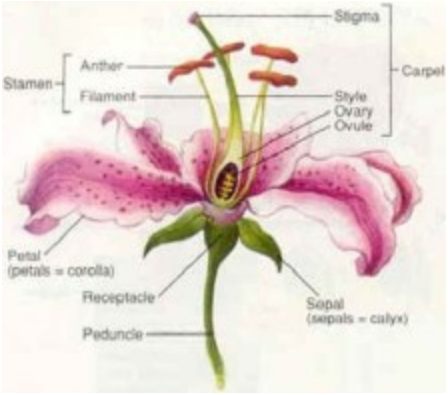
After fertilization, the ovary develops into a fruit while the ovules develop into seeds.

Stamen – It is collectively known as the androecium. They are the flower's Male reproductive organs. Most stamens have:

·Anthers – Pollen-producing organs. The pollen grains are fine yellowish particles, produced in the lobed region of the anther called pollen sacs.

·Filament – a long slender Stalk supporting anther

The types of flowers includes hypogynous, perigynous and epigynous flower.



Flower Part	**Form and Function**
Peduncle	Flower stalk.
Receptacle	Part of flower stalk bearing the floral organs, at base of flower.
Sepal	Leaf-like structures at flower base, protects young flower bud.
Calyx	All the sepals together form the calyx.
Petal	Located in and above the sepals, often large and colourful, sometimes scented, sometimes producing nectar. Often serve to attract pollinators to the plant.
Corolla	All the petals together form the corolla.
Stamen	Male part of the flower, consisting of the *anther* and *filament*, makes *pollen grains*.

Filament	The stalk of the stamen which bears the anther.
Anther	The pollen bearing portion of a stamen.
Pollen	Grains containing the male gametes. Immature male gametophyte with a protective outer covering.
Carpel\Pistil	Female part of the flower. Consisting of the stigma, style and ovary.
Stigma	Often sticky top of carpel, serves as a receptive surface for pollen grains.
Style	The stalk of a carpel, between the stigma and the ovary, through which the pollen tube grows.
Ovary	Enlarged base of the carpel containing the *ovule* or ovules. The ovary matures to become a *fruit*.
Ovule	Located in the ovaries. Carries female gametes. Ovules become *seeds* on *fertilization*.

Terms Associated with Flowering Plants

1. Apocarpous: Flowers with separate carpels.
2. Monocarpous: Consists of one carpel.
3. Syncarpous: With fused carpels.
4. Complete flower: One with all floral whorls.
5. Incomplete flower: One with one or more floral whorls absent.
6. Non-essential organs: Are the calyx and the corolla.
7. Essential organs: The androecium and gynoecium.
8. Regular flower: One that can be divided vertically into two similar halves.
9. Irregular flower: One that cannot be divided vertically into similar halves.
10. Hermaphrodite flower: One with both stamens and carpels.
11. Unisexual flower: One with either stamens or carpels but not both.
12. Monoecious: Plant with both male and female flowers borne on the same plant e.g. Maize.
13. Dioecious: With stamen and pistil on separate plants e.g. pawpaw.

14. Inflorescence: Group of flowers on same stalk e.g. sun flower.
15. Superior ovary: When the ovary is arranged above other floral parts on the receptacle.
16. Inferior ovary: When other floral parts are above the ovary.
17. Cross pollination: Transfer of pollen grains from anthers to a stigma of a flower of another plant but of the same species.
18. Self pollination: Transfer of pollen grains from anthers to a stigma of same flower or another flower of the same stand.
19. Dichogamy: The ripening of anthers and stigmas of a flower at different times.
20. Protandry: Where the anthers of a flower mature earlier than the stigma.
21. Protogyny: Where the stigma of a flower matures earlier than the anthers.
22. Homogyny: The ripening of both male and female flower at the same time.
23. Epigynous: This is a flower having inferior ovary. The receptacle forms ring around the ovary with sepals above the ovary e.g. sun flower.
24. Hypogynous: are flowers having superior ovary. All floral parts are above the receptacle e.g. mango.
25. Perigynous: These are flower with half inferior ovary. The ovary is covered halfway with other floral parts.

Placentation in Flowering Plants

Placentation is defined as the arrangement of the ovules within the ovary. There are various ways in which ovules are attached to the ridges of the ovary. These ovules are attached to the ovary by fleshy structures called placentae (singular: placenta) through short stalks called funicles.

Kinds of Placentation

The various kinds of placentation are:

·Marginal placentation (monocarpous pistil), e.g. cowpea

·Parietal placentation (syncarpous pistil), e.g. pawpaw

·Axile placentation (syncarpous pistil), e.g. tomato

·Free central placentation: (syncarpous pistil), e.g. cana lily

. Basal placentation (monocarpous pistil), e.g. sunflower.

Structure of an ovule

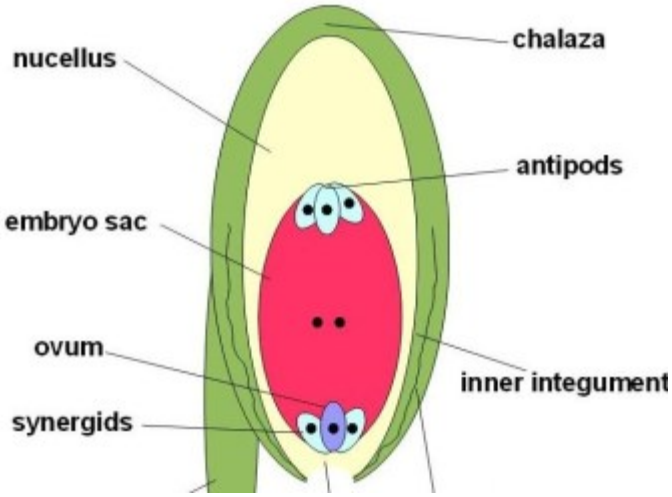
A mature ovule consists of:

·An embryo sac,

·Enclosed within a large mass of tissue, the nucellus,

·Surrounded by two protective shealths, the integuments, with

. A tiny opening, the micropyle.



Practice Questions

1. ____is the ripening of anthers and stigmas of a flower at different times
   a. Dichogamy
   b. Protandry
   c. Protogyny
   d. Homogyny
2. ____ is a flower having inferior ovary
   a. Dichogamy
   b. Protandry
   c. Protogyny
   d. Epigynous
3. _____ is the ripening of both male and female flower at the same time
   a. Homogyny
   b. Protandry

c. Protogyny
d. Epigynous

4. A situation where the anthers of a flower mature earlier than the stigma is called ____
   a. Dichogamy
   b. Protandry
   c. Protogyny
   d. Epigynous
5. ____ is defined as the arrangement of the ovules within the ovary
   a. Ovulation
   b. Free placentation
   c. Placentation
   d. Ovarian arrangement
6. _____ is the transfer of pollen grains from anthers to a stigma of a flower of another plant but of the same species.
   a. Self pollination
   b. Pollination
   c. Cross Pollination
   d. Protandry

Answers

1. A
2. D
3. A
4. B
5. C
6. C

WEEK: 10

Biology, SS 3, First Term

Topic: Reproductive Behaviour

Introduction

Reproduction is one of the characteristics of living things. It ensures the continuity of life. For sexual reproduction to be successful it involves the coming together of two opposite sexes, usually male and female. Courtship helps to bring close the two individuals that take part in sexual reproduction.

Courtship Behaviour in Animals

Courtship behaviour consists of instinctive behaviour in response to certain external stimuli in animals. It is a pattern of behaviour that precede mating and reproduction in animals.

Importance of Courtship Behaviour in Reproduction

Courtship behaviour normally aids reproduction in animals in the following ways:

1. Courtship brings the male and female animals together
2. It prepares male and female for possible mating
3. Courtship stimulates egg laying and sperm release in the partners
4. During courtship fertilization or reproduction is enhanced

Forms of Courtship Behaviour in Animals

The forms or types of courtship behaviour which are found in animals include:

- Pairing: This involves two animals, usually a male and a female, which separate themselves from others in a group to form a mating pair. This pairing may be very brief, just for the mating act only, or last for a lifetime.

Examples of Animals that Exhibit Pairing

Pairing in fish: During the breeding season, the male fish picks a female as a partner. They swim together to a quiet portion of the river. The male stimulates

the female to lay eggs. As the eggs are laid, the male releases sperms on the eggs for external fertilization.

Pairing in toad: During the breeding season, the male goes to a pond. It croaks, the croaking attracts and possibly excites the female. When the female comes close, the male mounts on the back of the female. The female carries the male on its back for 2-3 days. During this period, the female lays her eggs in shallow water, and the male pours sperm over the eggs for external fertilization to take place.
Other examples of pairing are found in birds, lizards and human.

- **Display:** This is an elaborate process involving a series of fixed patterns of movements or attractive exhibitions between mating partners. The partners must respond correctly to each other's display if the performance is to end in mating.

Types of Display
Display can take any of the following forms:

- Dancing, e.g. human beings
- Singing, e.g. human beings, birds,
- Croaking, e.g. toad,
- Nest making, e.g. birds
- Production of odour by female to attract the male

Examples of Courtship display:
Display in Agama lizard: The male Agama lizard displays its bright colours and approaches the female. The female lizard curves her back and lifts her tail vertically. The male then wags his tail, nods his head and grips her by the neck and pushes his

tail under her body so that their cloacas come into contact for copulation to take place.

Display in Birds: In domestic fowls, the male fowl called cock dances towards the female fowl called the hen. The cock lowers the wing on the side away from the hen, and dances in a staggering manner sideways towards the hen, beating the lowered wing against the body and legs as it moves. The hen runs away if it is not ready for courtship. If ready for courtship, the cock chases the hen, overtakes her, mounts on her back and pecks on her head while it stoops down and raises her tall feather, exposing the cloaca. Mating then takes place.

- Territoriality: is a form of behaviour in which a member of a species marks out a fixed area and defends it against intruders of the same species.

This behaviour pattern is exhibited by most vertebrates except the amphibians. In most cases, the males establish territories prior to mating. They may mark out their areas by scent markers such as urine or by patrolling along the boundaries. Intruding males are chased or scared away by their threat display. If a fight takes place, the male hardly hurt each other and the loser is allowed to run away. Females however, may be allowed to enter the territory.

Territorial behaviour ensures that breeding pairs or groups obtain adequate food and space. It also ensures that only the fittest individuals breed, passing on their favourable characteristics to their offspring. Male fishes, reptiles, e.g. Agama lizards, birds and mammals show great deal of territorial behaviour.

- Seasonal migration: is the movement of animals from one place to another which eventually return to the original place. Many species of animals migrate with seasons in connection with breeding and escaping unfavourable conditions.

Examples of Organisms which Exhibit Seasonal Migration

Fish: Many fresh water fish, e.g. the mud fish migrate from deep to shallow water before laying their eggs. In shallow water, the young fish are more likely survive as the water is too shallow for large animals which are likely to feed on the fish. The migration may be over short distances such as from the middle of a river to its side

or a long distance. At the beginning of the rainy season, the mud fish migrate upstream to areas where they spawn. At the beginning of the dry season, they return downstream.

Birds: Some birds, e.g. the cattle egret, during the dry season migrate from the northern part of Nigeria to the southern states as a result of lack of water, food and to escape the unfavourable weather of the north. During the rainy season, they migrate back from the south to the northern parts of the country where conditions for feeding and breeding have again become favourable.

Pollination

Pollination is the transfer of pollen from the anthers to the stigma. The pollen may be transferred from the anthers to the stigma of the same, or different flowers.
The pollen contains the male gametes (sperm) of plant. The pollen is transferred from the anthers where it is produced to the stigma where it germinates forming a pollen tube. The pollen tube then transfers the male gametes to the female gamete (egg cell) which is contained inside the ovules. Once the sperm reaches the egg cell it fuses with it to form a zygote and fertilization takes place.

Types of Pollination

When pollen is transferred from an anther to a stigma, it may be transferred within one flower or between two flowers. If the flowers are on two different individual plants, the flower has been cross pollinated whereas if the flowers are on the same individual, or if the anther and stigma are in the same flower, the flower has been self pollinated.

1. Self Pollination: It is the transfer of pollen grains from the anther to a stigma of same flower or another flower on the same stand.

Characteristics of Self-Pollinated Flower

- Their stigma and anther mature at the same time (Homogamy)
- Both the pistil and stamen are enclosed in the corolla. Fertilization occurs inside the enclosure. This is referred to as cleistogamy e.g. wood sorrel (Oxalis) and violets
- Anthers may be positioned above the stigma
- Filaments are longer than style and recoil

2. Cross Pollination: It is the pollen grains from the anthers to the stigma of another flower of another plant, but of the same species.

Characteristics of Cross-Pollinated Flowers

- Flowers are protandrous (i.e. anthers mature before the stigma)
- The flowers are protogynous (i.e. the stigma mature earlier than anthers)
- The flowers are unisexual i.e. with male and female parts borne differently
- Some have sterile stigma which will not accept pollen grains from their strand

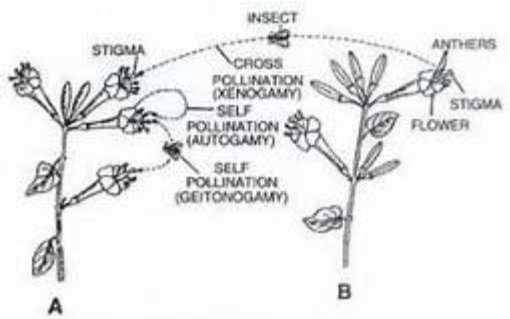


Fig. 2.16. Self and Cross pollination.

Differences between Self and Cross Pollination

	Self Pollination	Cross Pollination
1.	Self pollination takes place only in bisexual plants	Cross pollination takes place in both unisexual and bisexual plants
2.	Only one parents is involved	Two parents are involved
3.	Pollination may occur without an external agent	This requires external agents, e.g. insects and wind

4.	It does not ensure new varieties	It results in the formation of new varieties
5.	Pollen grains are effectively utilized	Much of the pollen grains are wasted

Major Agents of Pollination

Two major agents of pollination are wind and insects. Other agents of pollination are birds, water, and animals e.g. man

Characteristics of Insect Pollinated Flower

Insect pollinated flowers also called entomophilous flowers have the following characteristics:

- They have large conspicuous petals/sepals
- Flowers are usually brightly coloured
- They possess scent
- Nectar is also present
- Pollen grains are rough, sticky and relatively few
- The stigma is flat with sticky surface to enable it receive pollen grains
    - Petals are shaped and arranged to enable visiting insects become dusted with pollen grains

Examples of insect pollinated flowers include Hibiscus, Delonix, cowpea, crotalaria, pride of Barbados, etc.

Characteristics of Wind Pollinated Flowers

Wind pollinated flowers also called anemophilous flowers have the following characteristics:

- They have small, inconspicuous petals/sepals
- Flowers are usually dull coloured
- There is absence of scent
- There is absence of nectar
- Large quantity of pollen grains are produced

- Pollen grains are small, smooth, light and not sticky
- Stigma is elongated and sticky with large surface area
- Anthers are attached to the flower in such a way that they readily swing in the air and release the pollen grains

Examples of wind pollinated flowers are maize, guinea grass, rice, millet and wheat.

Practice Questions

1. _____ is the transfer of pollen from the anthers to the stigma
   a. Self pollination
   b. Pollination
   c. Cross Pollination
   d. Protandry
2. _____ is the pollen grains from the anthers to the stigma of another flower of another plant, but of the same species.
   a. Self pollination
   b. Pollination
   c. Cross Pollination
   d. Protandry
3. _____ is the movement of animals from one place to another which eventually return to the original place.
   a. Seasonal Migration
   b. Emigration
   c. Immigration
   d. Pollination
4. Cross pollination takes place in _____ plants
   a. Bisexual
   b. Unisexual
   c. Multisexual
   d. a & b
5. ____ is not an agent of pollination
   a. wind
   b. pollen

c. water
d. insects

Answers

1. B
2. C
3. A
4. D
5. B

SS 3
SECOND TERM NOTES ON
BIOLOGY

TABLE OF CONTENT

SECOND TERM

WEEK: 1

Biology SS 3, Second Term

Topic: Genetics: The Science of Heredity

Introduction

All living organisms reproduce. Reproduction results in the formation of offspring of the same kind. A pea plant produces only pea plants each time it reproduces. A rat produces only rats. Humans produce only humans. However, the resulting offspring need not and most often do not totally resemble the parent. Several characteristic differences may occur between individuals belonging to the same species. The similarities and differences among the members of a species are not coincidental. Both the similarities and differences have been received from their parents. The mechanism of transmission of characters, resemblances as well as differences, from the parental generation to the offspring, is called as heredity. The differences shown by individuals within the same species and in the offspring are described as variations. The scientific study of heredity, variations and the environmental factors responsible for these, is known as genetics.

What is Genetics?

Genetics is a branch of biology which studies heredity and variation. In other words, Genetics is the study of how genes bring about characteristics, or traits, in living things and how those characteristics are inherited. Scientists those study heredity, variation are called geneticists. The term genetics was coined by W. Bateson. Genes are portions of DNA molecules that determine characteristics of living things. Through the processes of meiosis and reproduction, genes are transmitted from one generation to the next.

What is Heredity?

Heredity is the transfer of characters from parents to offspring generation after generation and hence responsible for biological similarity between them.

It is the heredity because of which progeny is similar in various characters to either of its parent. This phenomenon by which progeny retains characters from parents is named as inheritance.

What is Variation?

Variation is the difference among the parents and offspring of these parents. Variation observed, can be because of two main reasons. So it is of two types based on these reasons.

·Hereditary variation

·Environmental variation

Only hereditary variations are transferred to progeny. Environmental variations belong to that generation only. These are not carried to the next generation.

Transmission and Expression of Characters in Organisms

Different characters (traits) are transmitted from parents to offspring (Progeny) and from generation to generation.

Hereditary Variation

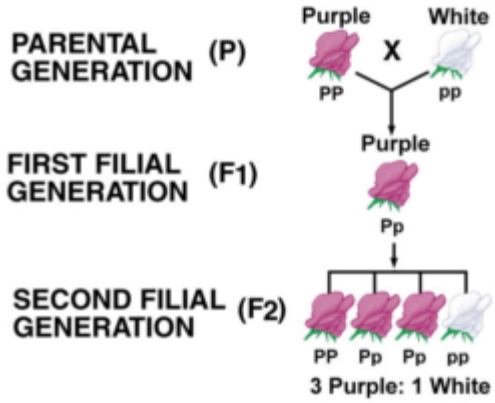
Hereditary variation refers to differences among individuals which can be passed from parents to their offspring (progeny). Hereditary variation arises because, apart from the case of identical twins, no two offspring inherit exactly the same set of characteristics from their parents. Each offspring inherits a different combination of characteristics from parents plants and animals have transmittable characters.

Transmittable Characters in human Beings

Transmittable characters in human beings include:

- Body stature or shape
- Shape of head, nose and ear
- Size of nose, head and ear
- Colour of skin, hair and eye
- Characteristic of voice or speech
- Intelligence
- Height of human
- Blood grouping
- Baldness

- Tongue rolling
- Sickle cell anaemia
- Haemophilia
- Colour blindness
- Fingerprint
- Ability to taste (BTC)



Transmittable Characters in Plants

Transmittable characters in plants include:

- Height of plant
- Size or weight of fruit
- Size of leaf
- Taste of fruit
- Food content of fruit
- Colour of leaf, flower, fruits or seeds
- Resistance to environmental factors like diseases, pests and drought
- Shape of leaf, fruit and flower
- Leaf texture
- Life span or habit of growth

Non-Transmittable characters

They are characters that are not transmitted from one generation to another e.g. the loss of ones leg as a result of an accident, the development of big muscles by a boxer, etc.

Some Important Terms Used In Genetics

Allele: One alternative of a pair or group of genes that could occupy a specific position on a chromosome.

Chromosome: A linear strand of DNA harboring many genes.

DNA: Deoxyribonucleic acid; the molecule in which genetic information is encoded.

Dominant: An allele producing the same phenotypic effect whether inherited heterozygously or homozygously; an allele that "masks" a recessive allele.

Gene: A unit of genetic information that occupies a specific position on a chromosome and comes in multiple versions called alleles.

Genotype: The genetic constitution of an organism.

Heterozygous: Having a genotype with two different and distinct alleles for the same trait.

Homozygous: Having a genotype with two of the same alleles for a trait.

Phenotype: The physical or observable characteristics of an organism.

Recessive: An allele producing no phenotypic effect when inherited heterozygously and only affecting the phenotype when inherited homozygously; an allele "masked" by a dominant allele

Haploid: Haploid is when an organism has one set of chromosomes in the gamete. It is represented by small letter (n)

Diploid: Diploid is when an organism has two sets of chromosomes in the body cell. The bodies of animals and plants are diploids. It is represented by (2n)

Mutation: Mutation is a change in the genetic make-up of an organism resulting in a new characteristic that inheritable.

Backcross: The cross of an F_1 hybrid to one of the homozygous parents; for pea plant height the cross would be Dd x DD or Dd x dd.

Testcross: The cross of any individual to a homozygous recessive parent; used to determine if the individual is homozygous dominant or heterozygous

Monohybrid cross: A cross between parents that differ at a single gene pair (usually AA x aa)

Dihybrid cross: Involves a study of inheritance patterns for organisms differing in two traits.

Mendel's Work in Genetics

Gregor Mendel (1822-1884) was an Austrian monk, known as the father of genetics. He made first systematic approach for the investigation of the mechanism of inheritance. He did a number of experiments on inheritance in pea plants.

Mendel described the basic patterns of inheritance before genes was discovered. He called "factors" to what we now call genes. Presented the results of his experiments under name "Experiments on Plant Hybridization" before the Natural History Society of Brunn 1865 and published paper in 1866. No one realized the importance of his work until 1900.

Mendel's brilliant and systematic work laid the foundation of a new branch of biology known as "genetics".

Rediscovery of Mendel's work

Mendel's work was rediscovered by Hugo de Vries in Holland and Carl Correns in Germany. They independently obtained the same results as those obtained by Mendel.

Why Mendel selected pea as experimental material?

1. Mendel observed that pea plant has various contrasting characters among its different varieties. He selected seven traits that are easily recognized and apparently only occur in one of two forms.

– Seed form is round or wrinkled
– Cotyledon color is yellow or green
– Seed coat color is grey or white
– Pod from is inflated or constricted
– Pod color is green or yellow
– Flower position is axial or terminal
– Stem length is tall or dwarf

2. Pea plant has perfect flowers.
3. Ordinarily self fertilized, but when cross pollination required can be easily crossed.
4. Pea plant is annual i.e. has short life cycle.
5. Can be grown and maintained in small space, with little expenditure.

Reasons for Mendel's Success

1. Proper maintenance of records i.e. observations of various characters in different generations.
2. Study of individual character so that systematic analysis is possible, no confusion.
3. Choice of material was right, reasons for this are as we have seen above.
4. Maintenance of purity, he used pure breeding parents.
5. Knowledge of shortfalls of earlier workers.
6. His mathematical background helped him a lot to understand and explain segregation of characters in F_2 and F_3 generations.

Practice Questions

1. _____ is the transfer of characters from parents to offspring generation after generation and hence responsible for biological similarity between them.
   a. Heredity
   b. Variation
   c. Genetics
   d. Mutation
2. ____ means having a genotype with two of the same alleles for a trait
3. An allele producing no phenotypic effect when inherited heterozygously and only affecting the phenotype when inherited homozygously is called a _____ allele
4. ____ is a change in the genetic make-up of an organism resulting in a new characteristic that inheritable.
   a. Heredity
   b. Variation

c. Genetics
d. Mutation

5. _____ is the study of how genes bring about characteristics, or traits, in living things and how those characteristics are inherited
   a. Heredity
   b. Variation
   c. Genetics
   d. Mutation
6. ____ means having a genotype with two different and distinct alleles for the same trait.
7. ____ is when an organism has two sets of chromosomes in the body cell. It is represented by (2n)
8. ____ cross is the cross of any individual to a homozygous recessive parent; used to determine if the individual is homozygous dominant or heterozygous
   a. Dihybrid
   b. Test
   c. Monohybrid
   d. Back
9. ____ is a unit of genetic information that occupies a specific position on a chromosome and comes in multiple versions called alleles
10. A ____ allele is an allele producing the same phenotypic effect whether inherited heterozygously or homozygously.

Answers

1. A
2. Homozygous
3. Recessive
4. D
5. C
6. Heterozygous
7. Diploid
8. B

9. Gene
10. Dominant

WEEK: 2

Biology, SS 3, Second Term,

Topic: Basis of Heredity

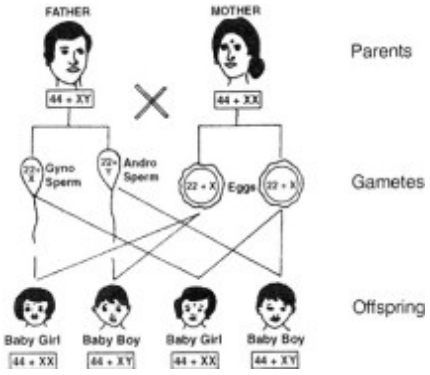
Introduction

In a human, the normal chromosomes complement is 46, 44 of which are autosomes while 2 distinct chromosomes are deemed sex chromosomes, which determine the sex of an organism and various sex linked characteristics.

In most animals, those who possess XX chromosomes are female while male animals possess an X and a Y chromosome. However, this is not true of all organisms, as it can be reversed in some species. A humans' sex is predetermined in the sperm gamete.

The egg gamete mother cell is said to be homogametic, because all its cell possess the XX sex chromosomes. Sperm gametes are deemed heterogametic because around half of them contain the X chromosome and others possess the Y chromosome to compliment the first X chromosome.

In light of this, there are two possibilities that can occur during fertilization between male and female gametes, XX and XY. Since sperm are the variable factor (i.e. which sperm fertilizes the egg) they are responsible for determining sex.



Chromosome

Our bodies are composed of millions of cells. Within the center of each cell are rod-like structures known as chromosomes. Typically, there are 46 chromosomes in each cell. They are grouped into 23 pairs, one member of each pair coming from our mother and the other from our father at the time of conception. The first 22

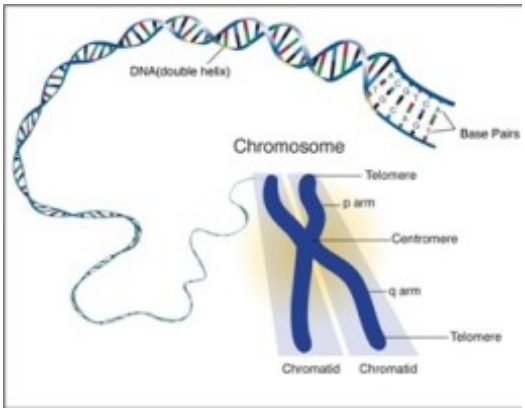
pairs of chromosomes are the same in both men and women and are number 1 through 22. The last two determine our sex and are call X and Y. Women have two X chromosomes and men have one X chromosome and one Y chromosome. Our chromosomes carry our genes, the basic units of heredity. Our genes are made up of DNA. There are approximately 30,000 genes that influence our growth and development.

Structure of a Chromosome

A chromosome is a condensed form of DNA that ensures it will not be cut during cell division. The long strands of DNA wrap around a core that consists of proteins called histones. 8 of these histone proteins are arranged in a very specific way so the DNA can wind smoothly around it. Once the DNA is wrapped around the histone core, it is now a chromosome.

Chromosomes have two parts called sister chromatids. Sister chromatids are identical to each other and were formed during DNA replication. They are held together by the centromere. Each sister chromatid will go into a different cell during cell division. This ensures each cell is an exact copy of the original cell and that it will function properly.

In most sexually reproducing organisms, chromosomes are arranged in homologous pairs. One of the chromosomes in the pair came from the organism's mother and one came from its father. These chromosomes hold the information for the same traits and the combination of both determines what phenotype the offspring will show.



Chromosomes and Genes

A gene is a specific sequence of DNA that codes for a trait. DNA is made up of four chemical bases which are represented by letters: adenine (A), guanine (G), cytosine (C), and thymine (T). Each chromosome contains many genes. Not all genes that are coded for are expressed. There are some that need environmental or other triggers in order to be expressed. Some traits are actually a combination of information from several genes on many different chromosomes.

Probability in Genetics

Probability is a branch of mathematics which can be applied to those events that depend entirely on chance. The probability that an event will occur in genetics is greater than zero and less or equal to 1.

Two basic rules of probability are helpful in solving genetics problems: the rule of multiplication (or the rule of and) and the rule of addition (or the rule of or).

– Rule of multiplication is that the probability that independent events will occur simultaneously is the product of their individual probabilities. For example:

Question:

In a Mendelian cross between pea plants that are heterozygous for flower color (Pp), what is the probability that the offspring will be homozygous recessive?

Answer:

Probability that an egg from the F_1 (Pp) will receive a p allele = 1/2.

Probability that a sperm from the F_1 will receive a p allele = 1/2.

The overall probability that two recessive alleles will unite, one from the egg and one from the sperm, simultaneously, at fertilization is: 1/2 X 1/2 = 1/4.

– Rule of addition is that the probability of an event that can occur in two or more independent ways is the sum of the separate probabilities of the different ways.

Question:

In a Mendelian cross between pea plants that are heterozygous for flower color (Pp), what is the probability of the offspring being a heterozygote?

Answer:

There are two ways in which a heterozygote may be produced: the dominant allele (P) may be in the egg and the recessive allele (p) in the sperm, or the dominant allele may be in the sperm and the recessive in the egg. Consequently, the probability that the offspring will be heterozygous is the sum of the probabilities of those two possible ways:

Probability that the dominant allele will be in the egg with the recessive in the sperm is 1/2 X 1/2 = 1/4.

Probability that the dominant allele will be in the sperm and the recessive in the egg is 1/2 X 1/2 = 1/4.

Therefore, the probability that a heterozygous offspring will be produced is 1/4 + 1/4 = 1/2.

Sex Linkage in Human-Beings

Characteristics whose genes are carried on the X chromosomes of the sex chromosomes are said to be sex-linked. Genes on the same chromosome are said to be linked because they tend to be inherited together. A sex-linked gene is a gene located on the x chromosome. Such genes are inherited along with such x chromosomes.

Examples of sex-link characteristics are:

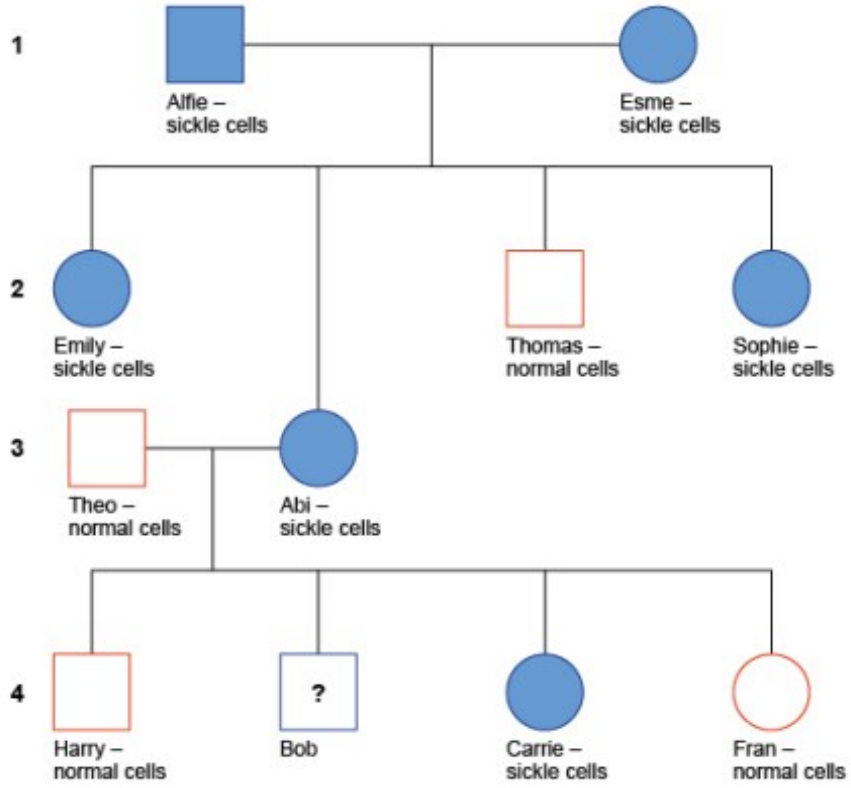
1. **Colour blindness:** Colour blind persons cannot distinguish near colours. It is an abnormality of the gene that controls the production of cone cells (light receptors) in the retina of the eye.
2. **Haemophilia (Bleeding disease):** Haemophilia is also an abnormality controlled by a recessive gene located on the x chromosome. Bleeding from a puncture or an open wound takes an abnormally long time to shop or fails to stop because clotting of blood wound not occur. Small injuries like puncture, extraction of tooth etc. can cause such persons to bleed to death.
3. **Baldness:** Baldness is equally an abnormality controlled by a recessive gene. It is a situation which results in the inability of the hair to grow on the upper (dorsal) part of the head. The recessive gene causes the hair to pull off prematurely. This is more common with male human beings.

4. **Sickle cell anaemia:** The sickle cell anaemia is controlled by a recessive gene which causes some of the red blood cells of some people to be sickle-shaped. The haemoglobin of the affected red blood cells is abnormally shaped and is inefficient in transporting oxygen. In a condition of low oxygen concentration, the haemoglobin breaks down causing the cells to become sickle-shaped. Such red blood cells block the cavities of small blood vessels in the body thereby hindering the free-flow of blood in them. Any part of the body affected receives insufficient blood, oxygen and nutrients. At such periods, the victim goes into crisis which is characterized by pains in the bones and joints, decrease in the level of haemoglobin, low oxygen concentration and a drastic fall in the level of blood fluid. This condition is called sickle cell anaemia and such sufferers are called sicklers.
5. **Albinism:** Albinism is the condition in which the skin of an animal is non-pigmented because of lack of the pigment called melanin. The expression of this trait is controlled by a recessive gene.

The Pedigree

A pedigree is a drawing of a family tree. The pedigree is used by genetic counselors and other medical professionals to assess families and try to spot patterns or indications which may be helpful in diagnosing or managing an individual's health. Pedigree uses specific symbols and "rules" so no matter who draws it, anyone can read and understand it.

Example of pedigree analysis



Application of the Principles of Heredity

Genetics is useful in many fields of human endeavour. Among its applications are:

Application of Genetics in Agriculture

The knowledge of the principles of heredity (genetics) is used in animal and crop husbandry to produce desirable breeds of animals and varieties of crops. The application is as follows:

- To increase yield: The varieties of crops and breeds of animals so developed by breeders are capable of giving high yield in crops and in animal products, e.g. meat, eggs or milk.
- To improve quality of product
- Development of early maturing varieties
- Development of diseases resistant varieties
- To obtain uniformity of plants
- To produce crops and animals that can adapt to climatic conditions

Application of Genetics Medicine

Genetics has contributed immensely in various field of medicine. These include:

- Determination of the paternity of a child
- Blood transfusion
- Marriage counseling
- Diagnosis of diseases
- Crime detection
- Development of test tube babies
- Choosing the sex of a baby
- Knowing the sex of a baby

Practice Questions

1. The normal human chromosomes are ____
   a. 44
   b. 46
   c. 44
   d. 42
2. Out of the 46 chromosomes, 44 are ___
   a. autosomes
   b. sex chromosomes
   c. genes
   d. DNA strands
3. ____ is also an abnormality controlled by a recessive gene located on the x chromosome and it is also called the bleeding disease
   a. Leukemia
   b. Anaemia
   c. Haemophilia
   d. Sickle cell
4. Albinism is the condition in which the skin of an animal is non-pigmented because of lack of the pigment called ___
   a. Keratin

b. Serotonin
c. Melanin
d. Albinin

5. _____ is an abnormality of the gene that controls the production of cone cells (light receptors) in the retina of the eye
   a. Night blindness
   b. Scurvy
   c. Beri-beri
   d. Colour blindness
6. A(n) _____ is a specific sequence of DNA that codes for a trait
   a. Chromosome
   b. Gene
   c. Autosome
   d. Sex chromosome

Answers

1. B
2. A
3. C
4. C
5. D
6. B

WEEK: 3

Biology SS 3, Second Term,
Topic: Variation in Population

Introduction

A population is defined as a group of organisms of the same species living in a specified area within a given period of time. All human beings in one geographical area constitute a population of human beings. Also, all cowpea plants in one geographical area at a given time form the population of cowpea plants.

Variation is defined as the differences which exist between individuals of the same species. All members of a population have some characteristics in common, by which they can be recognized as members of the species. At the same time, members of the same species have individual differences.

Types of Variations

There are two types of variation. These are:

Morphological Variation: This refers to the noticeable physical appearance of individuals of the same species. Morphological variation in turn gives rise to continuous variation. Continuous variation is variation that has no limit on the value that can occur within a population. Some examples of continuous variation are height, weight, heart rate, finger length, leaf length.

In human beings, morphological variations include:

· Height of the body
· Shape of various parts of the body such as head, mouth, nose, jaw, ears, eyes, legs and hands,
· Size of various parts of the body such as head, eyes, hands, necks
· Colour of parts of the body such as skin, eyes and hair
· Weight of individuals
· Hairiness of the body
· Finger print, etc.

Fingerprints: Fingerprints are made of an arrangement of ridges, called friction ridges. Each ridge contains pores, which are attached to sweat glands under the skin. You leave fingerprints on glasses, tables and just about anything else you touch because of this sweat.

All of the ridges of fingerprints form patterns called loops, whorls or arches:

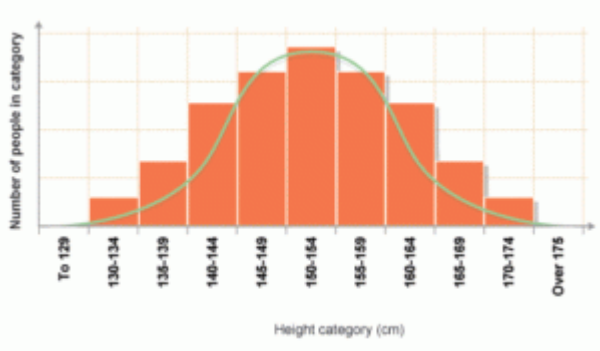
· Loops begin on one side of the finger, curve around or upward, and exit the other side. There are two types of loops: Radial loops slope toward the thumb, while ulnar loops slope toward the little finger.

· Whorls form a circular or spiral pattern.

Arches slope upward and then down, like very narrow mountains.

Physiological Variation: This is defined as different ways individuals vary in behaviour and function. In other words, physiological variation relates to the differences in the ways individuals of the same species behave or react to conditions in their environment.

Differences of variations in behaviour by which organisms can be grouped into two or more classes within a population, without any graduation among them are called discontinuous variation.



Examples of physiological or discontinuous variation in human beings are:

Behaviour: This may be grouped as being:

- Aggressive and non-aggressive
- Excitable or calm
- Timid or brave
- Caring or uncaring
- Intelligent or stupid
- Ability to roll the tongue
- Ability to close one eye and keep the other open
- Ability to move the ears without moving the head
- Ability to taste a chemical substance called phenyl thiocarbamide (PTC)
- Differences in blood group

Examples of Discontinuous Variation in Plant

- Colour of leaves
- Colour of flowers
- Colour of fruits

- Colour of seeds
- Shape of seeds and fruits

Causes of Variation

There are two major factors which may cause variation in living organisms. The factors are genetic differences and influence of the environment.

· **Genetic Differences**: Genetic differences are concerned with those traits that are inherited from parents. When parents bear children, each child inherits some characteristics of the father and some of the mother. It should be noted that no two children (except identical twins) inherit exactly the same combination of characteristics from father and mother. There are also in some cases when genes are altered or changed. Such a sudden change is called mutation. A mutation can be inherited and brings about a variation.

· **Influence of the Environment**: The environment plays an important role in the variation that may occur in human beings. Environment includes housing, food, health care, educational facilities, parental care, etc. A person who is intelligent which is derived from his parent may become dull if he is exposed to unfavourable environment, e.g. absence of schools, good food, inadequate medical attention, etc.

Application of Variations

Variation has wide application in human life. These applications include:

Crime detection: Morphological features which are peculiar to individuals can be used by police and other detectives to trace criminals. Examples of such features include height, colour of skin, colour of hair, colour of eyes and fingerprints. Physiological features such as rolling of tongue and differences in blood group are also used.

Blood transfusion: There are four main blood groups. These are A, B, AB and O. Blood groups are characterised by specific proteins in the blood and these are antigens in the red blood cells and antibodies in the blood plasma. Antigens are substances which will stimulate an animal to form protein compounds called antibodies. When a victim of an accident or a woman at birth loses large quantity of blood, it can be replaced with blood obtained from another person called the

donor. The victim receiving the blood becomes the recipient. The process of transferring blood from one person to another is called blood transfusion.

Note: People in blood group O can donate blood to people in all other groups; hence they are called universal donors. People in blood group AB can receive blood from people in the other groups hence they are called universal recipients.

Determination of paternity: In cases where the paternity of a child is in dispute, knowledge of blood groups is usually applied to resolve the dispute. In a hypothetical case of disputed paternity in which the blood groups of the child, mother and contesting fathers are found to be as follows:
Child —-> Group AB
Mother ——> Group A
Contesting father X ——-> B
Contesting father Y ———> O
The baby's genotype will be I^A and I^B and the mother will be IA or I^AI^A
Certainly I^B gene of the baby must have been inherited from the father X. the baby does not belong therefore to the contesting father Y in blood group O. The father of blood group O and the mother of blood group A can bear children of blood group A only with genotype I^A
In medicine: The knowledge of variation is used widely in various field of medicine. As a result of differences in skin colour, certain body cream are recommended for use differently between the black and white human races.
In agriculture: Animal and plant breeders make use of variations in animals and crops to develop better breeds of animals and varieties of crops that have high yield, taste, disease resistance, adaptation to local environment etc. Example is the development of yellow maize from white maize.
Classification of human race: Physical variation such as skin colour, shape of nose, texture of the hair, etc. have been used to classify the human race into four major groupings. These are:

1. **Caucasoid**: They are light skinned (white skin) people with narrow nose and wavy hair, e.g. European

2. **Negroid (negroes):** They have black skin with wholly hair and broad nose e.g. black African
3. **Mongoloid**: They are yellow-brown skinned people with straight hair and moderately broad nose, tiny eyes and flat faces e.g. Chinese and Japanese

4. **Australoid:** They are brown skinned people with curly hair and moderately broad nose e.g. Australian aborigines.

Practice Questions

1. _____ is defined as a group of organisms of the same species living in a specified area within a given period of time.
   a. Population
   b. Variation
   c. Succession
   d. Migration
2. Variation can be applied to the following except ___
   a. crime detection
   b. determination of paternity
   c. genetic difference
   d. blood transfusion
3. _____ are yellow-brown skinned people with straight hair and moderately broad nose, tiny eyes and flat faces
   a. Mongoloid
   b. Negroid
   c. Australoid
   d. Caucasoid
4. _____ variation is defined as different ways individuals vary in behaviour and function
   a. Discontinuous
   b. Morphological
   c. Physiological
   d. Continuous

5. One of the following is not a morpological variation
   a. Height of the body
   b. Shape of various parts of the body
   c. Size of various parts of the body
   d. Ability to roll the tongue
6. _____ is defined as the differences which exist between individuals of the same species.
   a. Population
   b. Variation
   c. Succession
   d. Migration
7. _____ are brown skinned people with curly hair and moderately broad nose
   a. Mongoloid
   b. Negroid
   c. Australoid
   d. Caucasoid

Answers

1. A
2. C
3. A
4. B
5. D
6. B
7. C

WEEK 4

Biology SS 3 Second Term

Topic: Evolution

Introduction

Organic evolution refers to the slow and gradual process by which living organisms have changed from the simplest unicellular form to the most complex multi-cellular forms that are existing today. Organic evolution primarily involves modifications in the existing organisms and the inheritance of these modifications. Biological evolution is genetic change in a population from one generation to another. The speed and direction of change is variable with different species lines and at different times. Continuous evolution over many generations can result in the development of new varieties and species. Likewise, failure to evolve in response to environmental changes can, and often does, lead to extinction.

Adaptation is defined as the possession of special features or structure which improves the chances of an organism to survive in its environment. In other words, adaptation is a change in an organism that makes it to adjust or survive in its environment. The survival requires measures in terms of structure, reproduction, and other processes developed by the organism in other to withstand the hazard (or danger) and biological changes that exist in the environment. This is called adaptive features.

Competition

In any biological community, there may be several things in short of supply for the organisms. We call these things resources, and the struggle to obtain them competition. Competition, in biology, is the relationship between members of the same or different species in which individuals are adversely affected by those having the same living requirements, such as food or space. In other words, Competition is a negative interaction that occurs among organisms whenever two or more organisms require the same limited resource. All organisms require resources to grow, reproduce, and survive. For example, animals require food (such as other organisms) and water, whereas plants require soil nutrients (for example,

nitrogen), light, and water. Organisms, however, cannot acquire a resource when other organisms consume or defend that resource. Therefore, competitors reduce each other's growth, reproduction, or survival.

Competition can be divided into two main types, intraspecific and interspecific competition. Whatever the type of competition, it will be strongest at high population densities. The more organisms there are, the more strongly they will compete for the remaining resources.

Intraspecific competition: This is a competition among members of the same species. Intraspecific competition occurs within the species. The niche overlap here is near 100%. Individuals of the same species compete for the exact same things in the environment, therefore this is the strongest type of competition. It is illustrated by some species of birds and mammals, the males of which set up territories from which all other males of the same species are excluded.

Interspecific competition: This is a competition among members of different species competing for the same ecologically limiting factors, such as a food source. It can be fierce, if the competing species are similar, but it is never as strong as intraspecific competition. It is easy to see why. Take squirrels and chipmunks, for example. They compete for acorns and a few other resources, but they do not compete with each other for nesting sites (squirrels nest in trees, chipmunks underground), or for mates (one hopes). Therefore while a chipmunk might have to work very hard to get acorns before a rival squirrel does, he will compete more strongly with another chipmunk who will also be after his nest and any female chipmunks in the area.

Within Species and Between Species

Competition can occur between individuals of the same species, called intraspecific competition, or between different species, called interspecific competition. Studies show that intraspecific competition can regulate population dynamics (changes in population size over time). This occurs because individuals become crowded as a population grows. Since individuals within a population require the same resources, crowding causes resources to become more limited. Some individuals

(typically small juveniles) eventually do not acquire enough resources and die or do not reproduce. This reduces population size and slows population growth.
Species also interact with other species that require the same resources. Consequently, interspecific competition can alter the sizes of many species' populations at the same time. Experiments demonstrate that when species compete for a limited resource, one species eventually drives the populations of other species extinct. These experiments suggest that competing species cannot coexist (they cannot live together in the same area) because the best competitor will exclude all other competing species.

Relationship between competition and succession
Succession is the progressive natural development of vegetation towards climax, during which one community is gradually replaced by others. This replacement might be some form of competition. It stands to reason then that succession can only occur after there has been competition. The weaker organism is succeeded by the stronger one after competing.

Types of Adaptations
There are three major types of adaptation. These are:

1. Structural adaptation
2. Adaptive colouration
3. Behavioural adaptation

Structural Adaptation: A structural adaptation is when an animal or a living thing is adapted to its environment by the way its body is built or shaped. Structural adaptations involve physical traits that can help an organism to survive in its environment. They can be its body shape, body parts, outer covering, colour or unusual life processes.

- Teeth – since different animals eat different things, they don't all have the same kind of teeth

- Body coverings – Hair, scales, spines, and feathers grow from the skin. All of these parts help animals survive in their environments.
- Movement – animals find food by moving from place to place

For example, the frog has webbed feet to help it to escape from its predators quickly and catch its prey faster.

Structural Adaptations for Feeding

Animals have developed distinct anatomical structures diagnostic of the food and the type of feeding they use. For example, the number, size, shape and location of teeth and the movement of the jaw differ in mammals according to the type of food they eat. The beaks of birds are highly specialized for food gathering and provide examples of the great diversity of diets even among related species. Other structures in the head are also involved in successful acquisition of food, such as strength and arrangement of jawbones, size and placement of muscles, and structure of the tongue. Of course, many other traits, such as the ability to hover, chase, or pounce, are integral to animals ability to get food.

Mammalian Teeth

The number and type of teeth an animal has reveals much about its diet and feeding methods. For example, the long canines of a carnivore, like a cougar, are used to bite and tear at prey. A beaver, on the other hand, is herbivorous, lacks canines, and uses its long incisors to strip bark and gnaw wood. Some teeth are rooted, meaning that once they come in, they do not continue to grow. Rooted teeth wear down with use. In contrast,rootless teeth keep growing throughout an animal's life. For example, the long incisors of the beaver are rootless. Beavers must continue to gnaw or their incisors will grow too long and cause problems, even death.

Four types of teeth are found in mammals. Each type of tooth is adapted to perform a particular function:

1. The incisors: which develop at the front of the jaw, are used for biting and stripping.

2. The canines: located behind the incisors, are generally designed for seizing, piercing, and tearing.
3. The premolars: are behind the canines used for crushing, grinding and shearing.
4. The molars: designed for crushing and grinding.

Not all mammals have all four types of teeth or the same number of each type. The number of different types of teeth an animal has is called its dental formula. Since mammals are bilaterally symmetrical, the same numbers of teeth are located on both the right and left side, so the formula states the number for half of the mouth, upper and lower. For example, the dental formula of a woodchuck is 1/1, 0/0, 2/1, 3/3 – that is, 1 upper incisor/1 lower incisor, no canines, 2 upper premolars/1 lower premolar, 3 upper molars/3 lower molars. The total number of teeth is 22.The dental formula in humans is 2/2, 1/1, 2/2, 3/3. The total number of teeth is 32.

Bird Beaks

There are numerous structural features of bird beaks that vary in adaptation to food and how it is obtained, although the relationship between bill structure and diet is not as predictable as it is for tooth structure in mammals. For example, woodpeckers have long, tough, pointed beaks, along with a very robust skull that allows them to hammer holes in trees in search of food. In general, the thicker the beak, the more appropriate it is for cracking large seeds, but even small, deep beaks are used to crack seeds (for example, the house sparrow). Thin beaks are generally useful for manipulating prey, like caterpillars. Wide beaks are useful for catching flying prey, like mosquitoes. Hooked beaks can be used in a similar way to a mammal's incisors (biting and stripping), and long slender beaks can be used to gather nectar from flowers, like those seen in hummingbirds. Other variations observed in beaks include serrated edges for holding prey (like fish), or filter-like structures used to strain food particles from water. For example, all raptors are carnivores that feed on other animals. However, each species of raptor occupies a different niche because each one specializes on a particular type or size of prey, relies on a different method of hunting, or hunt in different times of the day. Similarly shorebirds utilizes different depth of water and different types of prey and ducks can be either be herbivores, omnivores or carnivores and resulted into different beak structures.

Structural Adaptations for Flight – Wing structure

Wings of birds are modified forelimbs that function as airfoils, that is, convex on top and concave on the bottom so that the air going above the wing moves faster than the air below the wing. This creates an air pressure difference that provides an upward lift. In addition, many birds flap their wings to create lift and thrust for flight. The ability of birds to glide or fly depends on the ratio of the body mass to the surface area of the wings, called wing loading. In addition, the shape of the wing, the relative length, the width of the wing and feather arrangement all have effects on the wing's performance and suitability for different types of flight. Birds have other special features that are important for flight. Their bones are hollow with interior bracing and thus are both light and strong. Active, powerful flyers have skeletal adaptations of a large breastbone with a deep keel for flight muscles to attach. The relative size of this keel is an indicator of the strength of flight.

Adaptations for Defence and Protection

Chameleon uses photosensitive cells on its skin to pick the environment in which it finds itself as a measure of protection from its preys. Some insects have various ways of protecting or defending themselves. Some secrete repelling odours to drive away animals intending to attack them. The bee stings in order to defend itself. Other animals withdraw to their shells e.g. snails and tortoise

Adaptation for Securing Mates

The male peacock has beautiful feathers which it displays for the female so as to attract it before mating. The red-head Agama lizard raises it up and down to attract the female. Insect pollinated flowers are mostly brightly coloured.

Adaptation for Regulating Body Temperature

Mammals maintain a constant body temperature due to the presence of hairs, furs. These they use in trapping air inbetween pores in times of cold weather. That is why people living in temperate regions tend to be more hairy than those in tropics. The cold-blooded ones like fishes adjust using scales to give them the required temperature.

Adaptation for Water Conservation

Xerophytes possess thick cuticle and water reservoirs in their stems, thick backs to withstand loss of water, reduced sizes of leaves, at times thorns in place of leaves, all to reduce the rate of transpiration e.g. Baobab and Acacia. Camels are able to travel long distances in the desert without drinking water for day.

Practice Questions

1. ____ is defined as the possession of special features or structure which improves the chances of an organism to survive in its environment.
   a. Adaptation
   b. Variation
   c. Succession
   d. Population
2. _____ competition is a competition among members of different species competing for the same ecologically limiting factors.
   a. Intraspecific
   b. Interspecific
   c. Structural
   d. Behavioural
3. ____ is the progressive natural development of vegetation towards climax, during which one community is gradually replaced by others
   a. Adaptation
   b. Succession
   c. Variation
   d. Population
4. _____ is a competition among members of the same species.
   a. Intraspecific
   b. Interspecific
   c. Structural
   d. Behavioural
5. One of this is not a type of Adaptation
   a. Structural adaptation

b. Adaptive colouration
c. Behavioural adaptation
d. Functional Adaptation

Answers

1. A
2. B
3. B
4. A
5. D

WEEK 5

Biology, SS 3, Second Term

Topic: Behaviour Adaptation

Introduction

Behavioural adaptations are the way an organism behaves which helps it to survive in its environment. Behavior adaptations include activities that help an animal survive. Behavior adaptations can be learned or instinctive (a behaviour an animal is born with). Instinctive behaviour is a behaviour pattern that the organism naturally follows. Migration, hibernation and hunting behaviours are all behavioural adaptations that help an animal to survive in its habitat. For example, lizard hides under rocks to avoid gaining too much heat from the sun and survive in deserts.

Behaviour among the Groups:

1. **Aestivation:**Some remain dormant during dry season (e.g. mud fish) or during a prolonged drought or during shortage of food
2. **Hibernation:** This is when animals undergo dormancy especially in winter, during which metabolic rate is much reduced and the body temperature of homoeothermic species drops to that of the surrounding. Example is one found in bears, amphibians, reptiles and mammals.

3. **Dormancy:**Some seeds of plants and spores of microorganism might remain inactive due to unfavourable environment for years, until when the weather improves e.g. cyst formation in protozoa like amoeba
4. **Migration:**is the behavioral adaptation that involves an animal or group of animals moving from one region to another and then back again. Animals migrate for different reasons. The reasons are as follows:

- Better climate
- Better food
- Safe place to live
- Safe place to raise young

5. **Socialbehaviour:** Some animals live by themselves, while other live in groups. Those that live in group are so organized that there is division of labour among them, i.e. workers, soldiers, kings and queens as seen in termites. They live in colonies or communities. Examples of social animals include termites, bees, wasps, foxes, wolves, elephants, baboons and humans.
6. **Behaviourfor protection:** An animal's behavior sometimes helps to protect the animal. For instance the opossum plays dead. A rabbit freezes when it thinks it has been seen.

Adaptive Coloration

Adaptive colouration is the possession by an organism, of a colour which enables it to catch its preys, avoid its predators or enemies and ensure its survival. Flower colours, many animals, except mammals, can see both the visible and ultraviolet light. In addition, many birds exhibit structural coloration, due to microscopic structure of the feather so that depending upon the angle of illumination and view.

Some examples of adaptive coloration include:

Camouflage – This type of coloration allows an animal to visually blend in with its environment. This is both useful for predators to not be detected by the prey and for the prey not to be detected by the predator.

Disruptive coloration– Contrasting bold patterns tend to break up the outline of an animal so that it is difficult to identify. Although small to us, dark or light lines near the eyes tend to disguise the position of the eye, which is an important organ to be protected.

Deflective coloration – Many camouflaged birds have bright contrasting markings on the tail, wing or body part which become visible when the bird flies which may startle a predator and cause it to miss.

Counter-shading– Many birds have a darker top and white below. The effect of this is that the dark is lit by the sun and the light is in the shade. Further the light bottom side may reflect the colour of the ground, further making it difficult to see the bird until it moves. In Tilapia fish for example, the dark dorsal colour tends to blend with

the dark coloured water bottom and the silvery white ventral surface blends with the sky colour above them.

Warning coloration– Bright, contrasting colours warn predators that an animal is unpalatable or poisonous. Some animals mimic the warning colouration of poisonous animals to take advantage of the wariness of predators. Examples are the black and yellow bands of wasps and the lady birds (beetle)

Attractive coloration– Not all coloration is for concealment or to keep other animals away! Many animals display attention-getting coloration to attract mates or to lure prey.

Batesian mimicry: It is a condition in which a harmless organism resembles a distasteful or harmful one so that its enemies would avoid it. In other words, mimicry is the resemblance of an animal called a mimic to another different object, the model, in order to increase its chances of survival. Examples are: The swallow-tail butterfly has red colouration on the wing like a distasteful one and a grasshopper which mimics a living leaf.

Adaptive Colouration in Plants

Some plants also have adaptive colouration which enables them to carry out specific functions such as:

- **Pollination:** Many insect-pollinated flowers are brightly coloured so as to attract insects that pollinate the flowers
- **Feeding:** Some insectivorous plants such as nepenthes and saracenia have brightly coloured pitchers which attract insects that may fall into the pitchers, drown in the liquid in them and get digested.

Social Animals

Social animals are those in which individuals of the same species live together cooperatively in organized community known as societies or colonies.

A colony is a group of individuals belonging to the same species and organized in a cooperative manner. Examples of social animals are termites, bees, or wasps, ants, wolves, foxes and baboons.

Social Insects

Social insects are among the most dominant and prolific of all organisms on earth. Many insects exhibit "social" behaviors (e.g. feeding aggregations, parental care of the young and communal nest sites). In a broad sense, any insect that interacts with another member of its own species could be called a social insect. But as a rule, entomologists do not regard these behaviours as sufficient justification for classifying a species as truly social (i.e. eusocial). In order to qualify as eusocial, a species must exhibit all four of the following characteristics:

1. Share a common nest site
2. Individuals of the same species cooperate in caring for the young
3. Reproductive division of labor — sterile (or less fecund) individuals work for the benefit of a few reproductive individuals
4. Overlap of generations — offspring contribute to colony labor while their parents are still alive.

Species that lack one or more of these characteristics are classified as presocial. Within this category are subsocial species (in which the parents care for their offspring) and parasocial species (which have a common nest site but lack one or more of the other eusocial characteristics).

Termites

All members of the order Isoptera are eusocial insects. Termites feed primarily on the cellulose and lignin found in plant cell walls; these compounds are the main ingredients of wood and all paper products. Termites cannot digest the cellulose directly so they rely upon symbiotic bacteria and protozoa living within their intestines to supply most of the enzymes needed for cellulose digestion. Termites are sometimes called white ants. They may resemble ants in size, but ants have a narrow waist and elbowed antennae while termites have a thick waist and antennae that resemble a string of beads.

Ecologically, termites play an important role in the environment by:

1. Helping to break down and recycle dead wood and other plant tissues.
2. They become pests when their appetite for wood and wood products extends to human homes, fence posts, building materials, cardboard, and other valuable products.
3. In tropical and subtropical forests where termites are abundant, railroads must use expensive metal ties because wooden ones are quickly destroyed.

The Termite Colony: Each termite lives in a nest or colony with hundreds, thousands, or even millions of its brothers and sisters. In fact, the termite colony is really a large, extended family. Within this family, various groups of individuals have different functional roles according to a "caste system".

- The worker casteis the largest group. It consists entirely of immature, both males and females. These soft-bodied, wingless individuals perform all of the hard labour in the colony: they clean, maintain, and repair the nest, gather food and water, care for the young, and construct new tunnels and galleries as the colony grows. These juveniles all have the genetic capacity to undergo additional molts and become soldiers or reproductives, but most will spend their entire lives as workers.
- The soldier casteare larger in size but fewer in number than the workers. They are also wingless, but they have large heads with powerful jaws. Their job is to guard the nest site and protect it from attacks by ants or other invaders. There are two types of soldiers. These are the mandibulate soldiers which have strong mandibles for attacking intruders and the nasute soldiers which have projected mouthparts which can be used to inject poison into any intruder. The soldiers are unable to care for themselves so they must be fed and groomed by the workers.

The reproductive caste always includes a king (male) and a queen (female) who are the parents of the termite family and founders of the colony. Some species also have a few supplemental reproductives who share the egg laying duties. These are the only adult insects in the colony. The queen lays large numbers of eggs which

develop into more workers and soldiers as the family grows. In every mature colony, there also develops an annual population of young winged reproductives that swarm from the parent nest for a short mating flight. After flight, the delicate wings break off, and the new king and queen set out to find another nest site and start a new colony. Large colonies with multiple reproductives may also split into two or more daughter colonies, a process known as "budding".

The termite's caste system is regulated by pheromones. The king and queen each produce special pheromones that circulate throughout the colony and inhibit workers of the same sex from molting into reproductive adults. A death in the royal family (or an increase in the size of the colony) results in a lower concentration of the corresponding pheromone and, subsequently, one or more workers will molt into replacement reproductives. Likewise, the concentration of sex-specific soldier pheromones regulate the numbers of male and female soldiers to fall within an optimal range based on colony size. Excess numbers of soldiers or reproductives may be killed and eaten by the workers.

Behavioural Adaptation of Termite for Survival

1. The pattern of movement in a group or cluster enable them to ward off their enemies
2. The ability to feed on dead wood and living plants provide them with a wide variety of diet
3. Their burrowing activities into the soil or heart of wood or their ability to build tunnels offer them protection against enemies and adverse weather conditions.
4. The selective feeding of nymphs by workers, determines the caste a young one will eventually belong to.
5. The habit of feeding on dead members helps to keep the colony clean and healthy
6. Their ability to communicate enhances co-ordination
7. Production of many young ones ensure survival

Economic Importance of Termites

1. The clay obtained from anthill is used to build the surface of tennis court.
2. Termites help in loosening and aerating the soil through the tunnels they build
3. Termites destroy wood and furniture by their feeding habits
4. They produce a good source of protein and fats
5. There activities during the breaking down of wood help toad humus in the soil

Honey bees

This includes the well-known European honey bee (Apis mellifera) as well as 8 other species of Apis that are native to Europe, Asia, and Africa. These bees usually nest above ground, often inside hollow trees. They construct vertical wax combs with individual hexagonal cells for storing honey and rearing brood. Each hive is "ruled" by a single queen whose only job is to lay eggs. Workers are adult females — daughters of the queen. They perform all housekeeping chores within the hive, search for nectar and pollen, produce wax and honey, feed the young and protect the hive against enemies. Adult workers live for about six weeks (during the summer) but queens may last for several years. During cold winters, the bees cluster together, feeding on stored food reserves and sharing their body heat.

Social caste is determined mostly by the diet an individual bee receives during larval development. Normally, workers feed their larvae royal jelly (a nutrient-rich glandular secretion) for the first few days and then switch to a less-nutritious diet of bee bread (a mixture of honey and pollen). Larvae destined to become queens, however, are reared in special (larger) brood cells and fed a diet of royal jelly throughout the entire duration of larval development. Males (drones) develop from unfertilized eggs. Their only function is to mate with virgin queens.

A queen controls the social organization within her colony by means of a pheromone secreted from her mandibular glands. Workers lick this pheromone from the queen's body and pass it to nestmates during the exchange of food (trophallaxis). Queen pheromone maintains tranquility within the hive and inhibits ovarian development among workers. When the queen dies (or fails to perform adequately), she is replaced by a new queen reared from within the hive. Each colony, therefore, has the potential to be perennial, that is, to endure beyond the

lifespan of the founding queen and her workers. Mature, healthy colonies may grow to include as many as 80,000 workers. However, before they reach this size, most large bee hives will "reproduce" by swarming. This is a process of colony division in which an established queen leaves (absconds) with a large group of workers to establish a new nest site, while a young queen and the remaining workers stay behind to occupy the old nest site.

Honey bees use a variety of signals to communicate with nestmates. An aggregation pheromone produced by Nasanov's gland (located near the tip of the abdomen) is used to attract nestmates and to mark a source of nectar or water. An alarm pheromone is released from mandibular glands when the colony is threatened. Scout bees who find a good nectar supply will recruit foragers by passing out samples of the nectar and "dancing" on the comb to indicate distance and direction to the source.

- Drones are fertile males with stout body and large sized eyes. They copulate with queen.
- Queen is the fertile female with long and tapering abdomen. Its only main function is egg laying.
- Workers are sterile females with reduced ovaries. They have small body but with powerful wings, mouth parts and pollen collecting apparatus. These are adapted to prepare and repair the comb, to collect and store food, cooling of the hive and defence.

Economic Importance of Honey bees

1. Honey bees perform two beneficial roles to man. These are:
2. They help to pollinate flowers
3. They are source of honey

Practice Questions

1. _____ are the way an organism behaves which helps it to survive in its environment.

2. ___ are the sterile females with reduced ovaries in the honey bee colony
   a. Drones
   b. Queen
   c. Workers
   d. Soldiers
3. _____ is the fertile female with long and tapering abdomen in the honey bee colony
   a. Drone
   b. Queen
   c. Worker
   d. Soldier
4. _____ are those in which individuals of the same species live together cooperatively in organized community known as societies or colonies.
   a. Social animals
   b. Colonies
   c. Termites
   d. Honey bees
5. A ____ is a group of individuals belonging to the same species and organized in a cooperative manner
6. The ___ controls the social organization within the colony
7. _____ is a condition in which a harmless organism resembles a distasteful or harmful one so that its enemies would avoid it
   a. Adaptive colouration
   b. Batesian mimicry
   c. Disruptive colouration
   d. Counter shading
8. ____ is the type of coloration allows an animal to visually blend in with its environment
   a. Adaptive colouration
   b. Camouflage
   c. Disruptive colouration
   d. Counter shading

9. _____ is the possession by an organism, of a colour which enables it to catch its preys, avoid its predators or enemies and ensure its survival.
   a. Disruptive colouration
   b. Camouflage
   c. Warning colouration
   d. Adaptive colouration
10. _____ is when animals undergo dormancy especially in winter, during which metabolic rate is much reduced and the body temperature of homoeothermic species drops to that of the surrounding.
   a. Dormancy
   b. Aestivation
   c. Hibernation
   d. Social beaviour

Answers

1. Behavioural Adaptations
2. C
3. B
4. A
5. Colony
6. Queen
7. B
8. B
9. D
10. C

WEEK: 6

Biology

Topic: Adaptation for Survival

Introduction

Adaptation is defined as the possession of special features or structure which improves the chances of an organism to survive in its environment. In other words, adaptation is a change in an organism that makes it to adjust or survive in its environment. The survival requires measures in terms of structure, reproduction, and other processes developed by the organism in other to withstand the hazard (or danger) and biological changes that exist in the environment. This is called adaptive features.

Competition

In any biological community, there may be several things in short of supply for the organisms. We call these things resources, and the struggle to obtain them competition. Competition, in biology, is the relationship between members of the same or different species in which individuals are adversely affected by those having the same living requirements, such as food or space. In other words, Competition is a negative interaction that occurs among organisms whenever two or more organisms require the same limited resource. All organisms require resources to grow, reproduce, and survive. For example, animals require food (such as other organisms) and water, whereas plants require soil nutrients (for example, nitrogen), light, and water. Organisms, however, cannot acquire a resource when other organisms consume or defend that resource. Therefore, competitors reduce each other's growth, reproduction, or survival.

Competition can be divided into two main types, intraspecific and interspecific competition. Whatever the type of competition, it will be strongest at high population densities. The more organisms there are, the more strongly they will compete for the remaining resources.

Intraspecific competition: This is a competition among members of the same species. Intraspecific competition occurs within the species. The niche overlap here is near 100%. Individuals of the same species compete for the exact same

things in the environment, therefore this is the strongest type of competition. It is illustrated by some species of birds and mammals, the males of which set up territories from which all other males of the same species are excluded.

Interspecific competition: This is a competition among members of different species competing for the same ecologically limiting factors, such as a food source. It can be fierce, if the competing species are similar, but it is never as strong as intraspecific competition. It is easy to see why. Take squirrels and chipmunks, for example. They compete for acorns and a few other resources, but they do not compete with each other for nesting sites (squirrels nest in trees, chipmunks underground), or for mates (one hopes). Therefore while a chipmunk might have to work very hard to get acorns before a rival squirrel does, he will compete more strongly with another chipmunk who will also be after his nest and any female chipmunks in the area.

Within Species and Between Species

Competition can occur between individuals of the same species, called intraspecific competition, or between different species, called interspecific competition. Studies show that intraspecific competition can regulate population dynamics (changes in population size over time). This occurs because individuals become crowded as a population grows. Since individuals within a population require the same resources, crowding causes resources to become more limited. Some individuals (typically small juveniles) eventually do not acquire enough resources and die or do not reproduce. This reduces population size and slows population growth.

Species also interact with other species that require the same resources. Consequently, interspecific competition can alter the sizes of many species' populations at the same time. Experiments demonstrate that when species compete for a limited resource, one species eventually drives the populations of other species extinct. These experiments suggest that competing species cannot coexist (they cannot live together in the same area) because the best competitor will exclude all other competing species.

Relationship between competition and succession

Succession is the progressive natural development of vegetation towards climax, during which one community is gradually replaced by others. This replacement might be some form of competition. It stands to reason then that succession can

only occur after there has been competition. The weaker organism is succeeded by the stronger one after competing.

Types of Adaptations

There are three major types of adaptation. These are:

1. Structural adaptation
2. Adaptive colouration
3. Behavioural adaptation

Structural Adaptation: A structural adaptation is when an animal or a living thing is adapted to its environment by the way its body is built or shaped. Structural adaptations involve physical traits that can help an organism to survive in its environment. They can be its body shape, body parts, outer covering, colour or unusual life processes.

- Teeth – since different animals eat different things, they don't all have the same kind of teeth
- Body coverings – Hair, scales, spines, and feathers grow from the skin. All of these parts help animals survive in their environments.
- Movement – animals find food by moving from place to place

For example, the frog has webbed feet to help it to escape from its predators quickly and catch its prey faster.

Structural Adaptations for Feeding

Animals have developed distinct anatomical structures diagnostic of the food and the type of feeding they use. For example, the number, size, shape and location of teeth and the movement of the jaw differ in mammals according to the type of food they eat. The beaks of birds are highly specialized for food gathering and provide examples of the great diversity of diets even among related species. Other structures in the head are also involved in successful acquisition of food, such as strength and arrangement of jawbones, size and placement of muscles, and structure of the tongue. Of course, many other traits, such as the ability to hover, chase, or pounce, are integral to animals ability to get food.

Mammalian Teeth

The number and type of teeth an animal has reveals much about its diet and feeding methods. For example, the long canines of a carnivore, like a cougar, are used to bite and tear at prey. A beaver, on the other hand, is herbivorous, lacks

canines, and uses its long incisors to strip bark and gnaw wood. Some teeth are rooted, meaning that once they come in, they do not continue to grow. Rooted teeth wear down with use. In contrast, rootless teeth keep growing throughout an animal's life. For example, the long incisors of the beaver are rootless. Beavers must continue to gnaw or their incisors will grow too long and cause problems, even death.

Four types of teeth are found in mammals. Each type of tooth is adapted to perform a particular function:

1. The incisors: which develop at the front of the jaw, are used for biting and stripping.
2. The canines: located behind the incisors, are generally designed for seizing, piercing, and tearing.
3. The premolars: are behind the canines used for crushing, grinding and shearing.
4. The molars: designed for crushing and grinding.

Not all mammals have all four types of teeth or the same number of each type. The number of different types of teeth an animal has is called its dental formula. Since mammals are bilaterally symmetrical, the same numbers of teeth are located on both the right and left side, so the formula states the number for half of the mouth, upper and lower. For example, the dental formula of a woodchuck is 1/1, 0/0, 2/1, 3/3 – that is, 1 upper incisor/1 lower incisor, no canines, 2 upper premolars/1 lower premolar, 3 upper molars/3 lower molars. The total number of teeth is 22. The dental formula in humans is 2/2, 1/1, 2/2, 3/3. The total number of teeth is 32.

Bird Beaks

There are numerous structural features of bird beaks that vary in adaptation to food and how it is obtained, although the relationship between bill structure and diet is not as predictable as it is for tooth structure in mammals. For example, woodpeckers have long, tough, pointed beaks, along with a very robust skull that allows them to hammer holes in trees in search of food. In general, the thicker the

beak, the more appropriate it is for cracking large seeds, but even small, deep beaks are used to crack seeds (for example, the house sparrow). Thin beaks are generally useful for manipulating prey, like caterpillars. Wide beaks are useful for catching flying prey, like mosquitoes. Hooked beaks can be used in a similar way to a mammal's incisors (biting and stripping), and long slender beaks can be used to gather nectar from flowers, like those seen in hummingbirds. Other variations observed in beaks include serrated edges for holding prey (like fish), or filter-like structures used to strain food particles from water. For example, all raptors are carnivores that feed on other animals. However, each species of raptor occupies a different niche because each one specializes on a particular type or size of prey, relies on a different method of hunting, or hunt in different times of the day. Similarly shorebirds utilizes different depth of water and different types of prey and ducks can be either be herbivores, omnivores or carnivores and resulted into different beak structures.

Structural Adaptations for Flight – Wing structure

Wings of birds are modified forelimbs that function as airfoils, that is, convex on top and concave on the bottom so that the air going above the wing moves faster than the air below the wing. This creates an air pressure difference that provides an upward lift. In addition, many birds flap their wings to create lift and thrust for flight. The ability of birds to glide or fly depends on the ratio of the body mass to the surface area of the wings, called wing loading. In addition, the shape of the wing, the relative length, the width of the wing and feather arrangement all have effects on the wing's performance and suitability for different types of flight. Birds have other special features that are important for flight. Their bones are hollow with interior bracing and thus are both light and strong. Active, powerful flyers have skeletal adaptations of a large breastbone with a deep keel for flight muscles to attach. The relative size of this keel is an indicator of the strength of flight.

Adaptations for Defence and Protection

Chameleon uses photosensitive cells on its skin to pick the environment in which it finds itself as a measure of protection from its preys. Some insects have various ways of protecting or defending themselves. Some secrete repelling odours to drive

away animals intending to attack them. The bee stings in order to defend itself. Other animals withdraw to their shells e.g. snails and tortoise

Adaptation for Securing Mates

The male peacock has beautiful feathers which it displays for the female so as to attract it before mating. The red-head Agama lizard raises it up and down to attract the female. Insect pollinated flowers are mostly brightly coloured.

Adaptation for Regulating Body Temperature

Mammals maintain a constant body temperature due to the presence of hairs, furs. These they use in trapping air inbetween pores in times of cold weather. That is why people living in temperate regions tend to be more hairy than those in tropics. The cold-blooded ones like fishes adjust using scales to give them the required temperature.

Adaptation for Water Conservation

Xerophytes possess thick cuticle and water reservoirs in their stems, thick backs to withstand loss of water, reduced sizes of leaves, at times thorns in place of leaves, all to reduce the rate of transpiration e.g. Baobab and Acacia. Camels are able to travel long distances in the desert without drinking water for day.

ASSESSMENT

1. When resources gets scarce, population growth
   (a) becomes fast
   (b) slows down
   (c) remains same
   (d) none of above
2. As long as two species occupy different niches, there is
   (a) competition
   (b) no competition
   (c) no polymorphism
   (d) polymorphism
3. Population growth is checked by
   (a) competition

(b) no competition
(c) no polymorphism
(d) polymorphism

4. Two species can avoid competition, and better use environment's resources by occupying different
   (a) adaptations
   (b) polymorphism
   (c) nitches
   (d) specialization
5. Adaptation is caused by
   (a) Darwin's natural selection
   (b) Lamarck's ideas
   (c) Hardy
   (d) Weinberg

ANSWER

1. b
2. b
3. a
4. c
5. a