Topic 1 GROWTH AND DEVELOPMENT

The concept of Growth

Explain the concept of growth

Growth is an increase in size/mass or growth. It is the progressive development of living thing, especially the process by which the body reaches its point of complete physical development.

The growth process is not a steady one; sometimes growth occurs rapidly, at other times slowly. Individual patterns of growth vary widely because of differences in heredity and environment.

When the rate of cell increase is higher than the rate of cell loss, growth is referred to as positive growth. When the rate of cell increase is lower than the rate at which cells are lost from the body, the organism decreases in size and weight. This is also referred to as negative growth. Several factors are known to affect growth example nutrients, temperature, light and hormones.

Internal and External Factors Affecting Growth in Plants and Animals

Investigate internal and external factors affecting growth in plants and animals

Growth in plants and animals is influenced by a number of factors, which can be grouped into two categories: internal and external.

Internal factors affecting growth in humans

These are the factors which are associated with genetic make up of an organism plus all the other processes which take place in the organism's body. These factors include the following:

Heredity:A person's physical development is strongly affected by their genes inherited from their parents. Parent's genes predetermine the limits of an individual's height and other characteristics including the variability in eye colour, hair colour, body composition, and skin tone.With physical attributes such as height, parents' genes dictate the range of height their offspring can obtain. The variability in height is a result of many external factors in the environment including nutrition and events during the child's growth.

Hormones: Human growth is affected by biochemical products such as hormones. Hormones are regarded as growth-promoting substances. Probably all the endocrine glands influence growth. Most of the hormones are secreted by the endocrine glands and play a significant role in regulating the pattern of growth and development as per instructions of the genes. Examples of these hormones and their actions are as follows:

Somatotrophin:The most important hormone controlling growth from birth up to adolescence is growth hormone or somatotrophin. This is a polypeptide secreted by the pituitary. It helps in

growth of bones and thereby increases the height of persons. It also causes an overall growth rate of most of tissues including brain.

Thyroid hormone:This hormone plays a vital role throughout the whole period of growth. The activity of the thyroid decreases gradually from birth to adolescence. In low secretion of the hormone, skeletal maturity, dental maturity and growth of the brain are all affected. During adolescence a new phase of growth occurs under the control of steroid hormones secreted by the adrenals and gonads. The gonads of both sexes secrete estrogens in small quantities from the time of birth onwards. At puberty the oestrogen level rise sharply in girls and to a much more limited extent in boys; the sex differences is possibly due to an inhibitory hormone secreted by the seminiferous tubules of the testicle.

Testosterone:Testosterone, produced by the testicle, is important in stimulating growth and it is responsible for the greater growth of muscles.

Gonadotrophins:Gonadotrophins are responsible for the growth of the ovaries and testis, and later on, the secretion of estrogens and testosterone responsible for the growth and development of secondary sex characters.

External factors affecting growth in humans

Growth is also affected by external factors which include the following:

Nutrients: Growth is closely related to nutrition. A sufficiency of food is essential for normal growth. An adequate supply of nutrients is naturally essential for the normal growth of humans and the need varies with the phase of development. For example: Zinc plays a part in protein synthesis and is a constituent of certain enzymes. A deficiency of zinc causes stunting, interference with sexual development and falling out of hair; Iodine is needed for the manufacture of the thyroid hormones; Bone will not grow properly without an adequate supply of calcium, phosphorus and other inorganic constituents such as magnesium and manganese; Iron is required for the production of haemoglobin; Vitamins play an important part in growth. Vitamin A is thought to be control the activities of osteoblasts. In vitamin C deficiency the intercellular substance of bone is inadequately formed. Vitamin D deficiency is the cause of rickets. Malnutrition during childhood delays growth, and malnutrition in the years proceeding adolescence delays the onset of the adolescence. Malnutrition may also result to diseases which decrease the appetite or interfere with digestion and assimilation. A majority of malnourished children fail to achieve their full genetic potential of body growth and are thus stunted or wasted or both.

Diseases: Diseases are alteration of the normal body functions, disorders or morbid conditions of the mind. Diseases slow down growth in humans and other animals. A child that suffers from diseases very often is likely to have his growth stunted or retarded. Such a child may end up having a small body or deformed body parts.

Cultural factors: The physical growth of human beings is definitely affected by cultural factors. Culture differs from ethnic group to ethnic group. The body growth differences correlate with varied cultural groups. The physical growth of the body follows some adaptations in different geographical areas of distribution of the groups.

Socioeconomic factors: Socioeconomic influence on human growth is also a well known factor. Children from different socioeconomic levels differ in average body size at all ages. It is clear that growth of the children and adults in those families with good financial status is always good compared to the case in poor families. However, growth differences are more closely related to the home conditions than to the strictly economic status of the families.Size of family exerts an indirect influence on the rate of growth. In a large family with limited income the children do not get proper nutrition. As a result the growth is affected. The number of children in the family exerts an effect on the children's rate of growth. Children in large families are usually smaller and lighter than children in small families. Possibly this is because in large families children tend to get less individual care and attention.

Internal factors affecting growth in plants

The internal factors that influence plant growth include following:

Hereditary factors

Heredity factors are internal factors that affect the growth of plants. They affect the physical appearance and the size of a plant

Hereditary units called genes are found in chromosomes inside the nucleus of all plant cells. These units control the various characteristics of plants such as flower colour number of floral parts, growth pattern and so on. Genes are passed from parents to off spring. For example, tall plants produce tall offspring and short plants produce short offspring.

Growth hormones

Certain hormones such as growth hormones are known to affect growth. Hormones are chemical substances that influence physiological processes. Drastic changes in their concentrations in the body will, therefore, affect growth.

There are several known growth hormones. Some of them, like auxins, cytokinins are growth-promoting while others like abscissic acid and ethylene are growth inhibitors. Most of the growth regulators are synthesized by plants while a few are synthetic in nature.The table below summarizes the role of certain plant hormones on growth of plants and seeds.

Hormone	**Role in plant growth**
Indoleacetic acid(IAA)—the main auxin.	Promotes cell division

Other three auxins seem to have rather marginal importance for plants in natural environments.	Promotes cell enlargement Promotes response of shots and roots to stimuli such as light, water and gravity Promote growth of adventitious roots Induces parthenocarpy (formation of fruits without fertilization) Causes formation of the abscission layer at the base of the leaf stalk, leading to falling of leaves (abscission). Inhibits development of lateral buds, thus promoting apical dominance Causes formation of callus tissue. Callus tissue forms at the site of an injury to bring about healing in the plant. Controls division in the vascular cambium and xylem differentiation. Used as the rooting hormones in stem cuttings. 2-4 D is used as an herbicide to kill broadleaf, dicotyledonous weeds. Promotes flowering in pineapples.
Gibberellins	Promote cell division and elongation of internodes in dwarf plants. Induce parthenocarpy by initiating formation of indoleacetic acid (IAA) Promote lateral bud development Inhibit development of adventitious roots Inhibit formation of the abscission layer on the leaf petiole Promote germination of seeds

	It helps in inducing seed germination by breaking seed dormancy and initiating the synthesis of hydrolases enzymes for digesting reserve food.
Cytokinins	Stimulate cell division Stimulate formation of callus tissue Promote flowering Break seed dormancy Promote formation of adventitious roots Promote development of lateral buds by inhibiting apical dominance. Low concentration of clytokinin induces cell elongation and causes ageing of leaves Help in the production of new leaves, chloroplasts, and adventitious shoots. Help in delaying senescence by promoting nutrient mobilisation.
Ethylene (ethane)	Promotes ripening of fruits Causes formation of callus tissue, leading to falling of fruit and leaves Stimulates thickening of the stem while inhibiting stem elongation Helps in breaking seed and bud dormancy. Promotes root-growth and formation of root hairs.
Abscisic acid (ABA)	induces seed dormancy by inhibiting seed germination, growth of stems, and sprouting of buds Causes fruits and leaves to fall (abscission)

	Promotes flowering Stimulate apical dominance by suppressing development of lateral buds Stimulates stomatal closure during water stress
Indolebutyric acid	Synthetic plant hormone that promotes elongation of stems and roots

Apical dominance

An apical bud is found at the top of the plant. Apical buds are responsible for increase in plant's height (apical growth). Lateral buds are found on the sides of the plant. Lateral buds are responsible for the formation of branches. Apical dominance is the inhibition of the growth of lateral buds by the presence of the growing apical bud. Apical dominance causes plant shoots to have a conical shape.

The apical bud produces auxins that diffuse to the lower parts of the plant. These auxins retard the development of lateral buds. The lateral branches of such a plant are short. A plant that has strong apical dominance gains more height in comparison to its width. Thus the plant assumes a conical outline.

Cutting the apex of the shoot causes the lateral buds to sprout. The dominance is overcome since the source of auxins at the apex is removed. The lateral buds sprout, branches develop, and the plant assumes an umbrella shape. Tea bushes are pruned so that they can develop many side branches. Rose plant, cypress and bougainvillea plants are pruned so that they can make a good hedge.

External factors that affect growth in plants

The external factors that affect plant growth include light, nutrients, temperature, relative humidity, water, carbon dioxide and oxygen, soil condition, biotic factors, and pollutants. Each of these factors is explained in detail below:

Light: The effect of light on growth can be studied under three headings: **light intensity**, **light quality** and **duration of light**. Growth is generally favoured by darkness, but light is necessary because of its role in the manufacture of food. Young plants growing in the absence of light develop elongated thin stems with narrow leaves and poorly developed shoot system. Such plants are said to be **etiolated**.In weak intensity of light the internodes are short and the leaves are expanded. In strong intensity of light, the plant assumes a normal height. Very low light intensity reduces the rate of overall growth of the plant, by lowering the rate of photosynthesis.Growth in

full spectrum of visible light is found to be better than the growth in any one of the different colours of light. Red colour seems to be the most favourable for growth.The duration of light has a pronounced effect on the growth of vegetative as well as reproductive structures. The influence of duration of light is most marked in inducing or suppressing flowering. This phenomenon is termed as **photoperiodism**.

Nutrients: Availability, quality and quantity of food substances will automatically affect growth. For growth to occur in living things, food must be broken down to release energy. In areas where nutrients and water are adequate, competition is reduced and population increases. In case of shortage of nutrients and water, competition sets in and most individuals die.There are different mineral nutrients required for optimum plant growth. These nutrients are classified as either macronutrients or micronutrients. Macronutrients are those nutrients required by plants in high doses while micronutrients are the nutrients required in small quantities. Examples of macronutrients include nitrogen, potassium, magnesium, calcium, phosphorous and sulphur. Micronutrients include iron, zinc, molybdenum, manganese, boron, copper, cobalt and chlorine.

Temperature: Atmospheric and soil temperatures are very crucial for plant growth as it affects many plant processes such as photosynthesis, metabolism, respiration, transpiration, breaking of seed dormancy, seed germination, protein synthesis, translocation, and flowering. At high temperatures the translocation of manufactured food is faster so that plants tend to mature earlier.Growth can take place between 0°C and 50°C. But the optimum temperature for the growth is between 20° and 30°C. Low temperature, however, is necessary for many plants to flower. Different physiological processes such as photosynthesis and respiration are controlled by enzymes. The enzymes are affected by temperature and pH. Enzyme activity and the rate of most chemical reactions generally increase with rise in temperature. Up to a certain point, there is doubling of enzymatic reaction with every 10°C temperature increase. But at excessively high temperatures, denaturation of enzymes and other proteins occur.It follows, therefore, that drastic changes in temperature and pH will affect growth.

Relative humidity: Relative humidity (RH) is the amount of water vapour in the air, expressed as the proportion (in percent) of the maximum amount of water vapour it can hold at certain temperature. For example, an air having a relative humidity of 60% at 27°C temperature means that every kilogram of the air contains 60% of the maximum amount of water that it can hold at that temperature.The relative humidity affects the opening and closing of the stomata which regulates loss of water from the plant through transpiration as well as photosynthesis. Transpiration is slower in humid conditions. This is because diffusion of water vapour out of the leaf slows down if the leaf is already surrounded by moist air.

Water: As mentioned earlier, water is a primary component of photosynthesis. It maintains the turgor pressure or firmness of tissue and transports nutrients throughout the plant. In maintaining turgor pressure, water is the major constituent of the protoplasm of a cell. By means of turgor pressure and other changes in the cell, water regulates the opening and closing of the stomata,

thus regulating transpiration. Water also provides the pressure to move a root through the soil. Among water's most critical roles is that of a solvent for minerals moving into the plant and for carbohydrates moving to their site of use or storage. Gradual evaporation of water from the surface of the leaf near the stomata helps stabilize plant temperature.

Carbon dioxide and oxygen: The oxygen and carbon dioxide in the air are of particular importance to the physiology of plants. Oxygen is essential in respiration for the production of energy that is utilized in various growth and development processes. Carbon dioxide is a raw material in photosynthesis. However, a high concentration of carbon dioxide reduces growth because of its effect on the closing of stomata, and maintenance of dormancy. If the concentration of carbon dioxide in the plant leaf is higher than the surrounding air, the stomata will open to let in more of the gas from the surrounding air so as to balance the equilibrium of the gas between the two media (air and leaf air spaces). The opposite is the case if the concentration of the gas is higher in the air than in the leaf.

Soil condition: The characteristics of soil play a big part in the plant's ability to extract water and nutrients. If plants are to grow to their potential, the soil must provide a satisfactory environment for plant growth.Plant growth is influenced by the soil properties such as texture or structure, salinity, acidity, waterlogging, or compaction.

Biotic factors: Diseases, plant pests, weeds and harmful substances released by roots (allelopathy) affect plant growth drastically. Weeds compete with plants for moisture, nutrients, and light. Root knot nematodes reduce absorption, so more fertilizer is necessary. All of these have negative impacts on plant growth and development.

Pollutants: Pollutants can hamper plant growth. Many pollutants composed of poisonous gasses (such as carbon monoxide, sulphur dioxide, hydrogen fluoride, hydrogen sulphide) are capable of restraining growth, even bringing plants to death. Pollutants from household or industrial wastes are also able to restrain plant growth.

Mitosis and Growth

The Concept of Mitosis

Explain the concept of mitosis

Mitosis is the process of cell division whereby the chromosome are duplicated and distributed equally to the daughter cell.

The process of mitosis takes place in several stages, which are described below. The diagrams illustrate the stages showing a simple cell with four chromosomes.

Stages of Mitosis

Illustrate stages of mitosis

PROPHASE

This is the first stage of mitosis. In the early stages thread-like structures appear in the nucleus. These structures are the chromosomes. With time the chromosomes shorten and thicken. Then each of them splits longitudinally into two structurechromatids.Each of the chromatids is held together at a point calledcentromere.

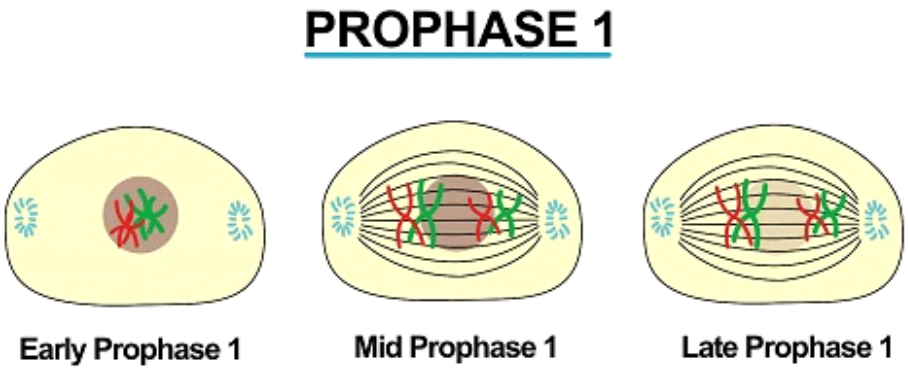


Diagram of early prophase

As the chromosomes become visible, other events tae place. The nuclear membrane and the nucleus gradually disappear and a network of fibers appears in the cytoplasm. This network of fibers is referred to as spindle.

METAPHASE

Prophase is followed by metaphase stages. The nuclear membrane has disappeared completely by the cell and become arranged. The centromere of each pair of chromatids is attached to a spindle fiber.

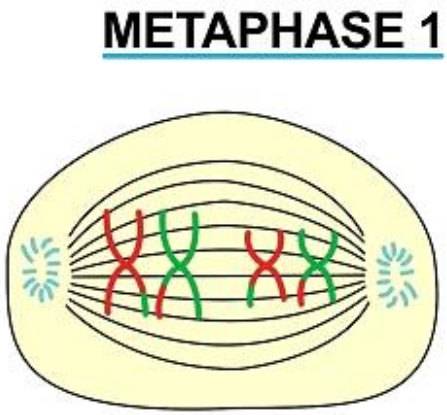
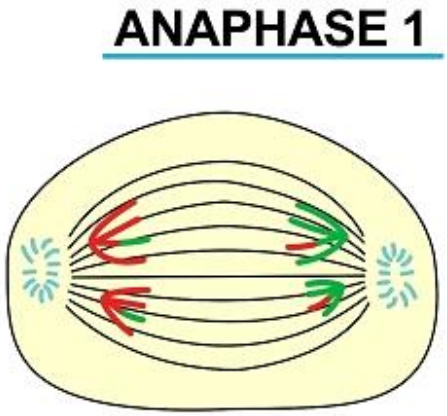


Diagram of metaphase

ANAPHASE

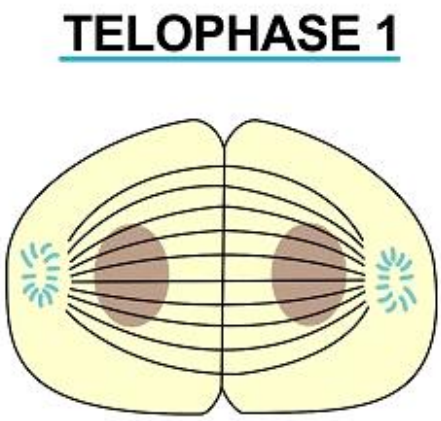
During anaphase the centromere splits and the sister chromatids separate from each other (see figure below). Once the sister chromatids separate from each other, each is referred to as chromosome. It follows, therefore, that at this stage the chromosome number in the cell has doubled. Then the chromosomes begin to move towards opposite sides of the cell. The movement is in such a way that an equal number of chromosomes move to each pole of the cell.



TELOPHASE

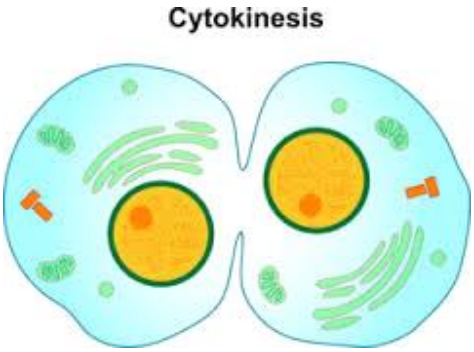
Telophase begins when chromosomes reach the poles of the daughter cells. Many events in the telophase are the reverse of prophase. The chromosomes uncoil the nuclear membranes around

daughter nuclei appear, the spindle apparatus break down and the nucleus reappears and nuclear membrane forms around each mass of chromosomes.



CYTOKINESIS

Telophase is followed by a stage calledcytokinesis. This is the division of cytoplasm. In plant cells a delicate membrane called a cell plate starts to form in the middle of the cell. Finally a new cell wall forms on either side of the plate. In this way, two new daughter cells are formed. In animals cells the cell membrane pinches the cytoplasm at the middle of the cell until two daughter cells are formed. Cytokinesis is completed as telophase ends.



The Significance of Mitosis in the Growth

Explain the significance of mitosis in the growth

SIGNIFICANCE OF MITOSIS IN GROWTH

- Mitosis results in the formation of two identical daughter cells
- The daughter cells are also identical to the parent cells because each daughter cell has the same number of chromosomes as that found in the original cell

- Mitosis enables an organism to increase in size and maintain the same number of chromosomes in its body cell
- Mitosis is also important for the replacement of worn out or damaged cells example in the lining of the gut and the surface of the skin

Mitosis alone does not bring about growth, when the cell divides the two daughter cells are initially only half the size of the parent cells.

The new cells must take in more materials to form the additional cytoplasm to produce fully-grown cells.

Growth and Developmental Stages in Human

Growth and Development in Human being

Explain growth and development in human being

Growth is irreversible increase in size. It is usually accompanied by cell division. Growth can be shown by increase in mass, length, surface area and numbers. Development refers to increase in complexity and differentiation of tissues and organs.

Human growth and development are lifelong processes of physical, behavioural, cognitive, and emotional growth and change. At every stage of life, there are physical and psychological changes in the human body. The process takes many years and a person goes through many different growth stages to reach adulthood, the final stage of development. Although every person experiences growth and development uniquely, the patterns are similar for all humans as shown in the growth curve below. In this particular graph, the selected growth parameter measured is height.

The Stages of Human Post–natal Growth and Development

Explain the stages of human post–natal growth and development

Growth and development in humans can be prenatal or postnatal. Prenatal growth and development takes place in the womb before a baby is born. Post natal growth and development occurs after the baby is born.

Even though the terms growth and development are used interchangeably, there are specific differences between them. We can sum up the differences between growth and development in the following table.

Growth	**Development**
Growth refers to increase in size, height,	Development refers to improvement in the

weight etc.	functioning of the body process
Easily measured and observed	Cannot be measured easily
It is limited. Starts with birth to reach the maximum at maturity	A continuous, unending process all through life.
Limited to specific areas	Concerned with various aspects and parts of body and behaviour as a whole
Quantitative change	Qualitative and Quantitative change

Human beings and other mammals show **limited growth**. Limited growth is growth that ceases at maturity. In these cases, therefore, the growth curve flattens or even declines prior to death. The decline is due to decline in smooth functioning of the organism, culminating to death. This is called **senescence**.

Other mammals and plants grow throughout their lives. This type of growth is called **unlimited growth**.

Lymph tissue grows very fast in early human life so that it produces a lot of white blood cells to fight infection (because the immune system is not able to fight infection). This type of growth in which organs grow at different rates is called **allometric growth**.

The post-natal period is a period beginning immediately after the birth of a child. The human post-natal growth and development may be divided into five phases or stages. These different stages of post-natal growth are summarised in the table below:

S/No	**Stage**	**Age span**
1	**Infancy**	From birth to two years
(i)	Neonatal	From birth to 4 weeks
(ii)	Older baby	From 6 to 12 months
(iii)	Toddler	From 1 to 3 years
2	**Childhood**	From 3 to 12 years
(i)	Early childhood	From 3 to 6 years
(ii)	Late childhood	From 7 to 12 years or in strict sense up to the onset of puberty

(iii)	Pre-adolescence	From 10 to 11 years
3	**Adolescence**	From 13 to 19 years or in a strict sense from onset of puberty till the attainment of maturity
4	**Adulthood**	From 20 to 60 years or in strict sense from attaining maturity to the age one ceases to produce one's own kind
(i)	Early adulthood	From 20 to 40 years
(ii)	Late adulthood	From 40 to 60 years
5	**Old age or ageing (senescence)**	From 60 years or in a strict sense from the end of the reproduction capability stage till death

NOTE: *The age spans at which different stages of human growth and development occur are very confusing! So don't stick your mind to the age spans because there are no defined ages at which each stage exactly occurs. For example, the term infant is typically applied to young children between the ages of 1 month and 12 months; however, definitions may vary between birth and 1 year of age, or even between birth and 2 years of age. The same case applies to the definition of a toddler. There is simply no consensus about what constitutes a toddler. That said, rough estimates about when toddlerhood begins vary greatly and are widely accepted in the medical literature. Some will define a toddler as an infant between the ages of 1 and 3. However, some literatures define a toddler as an infant between 1 and 2 years. Confusing!*

Physiological, Psychological and Behaviour Changes Associated with Growth and Development

Explain physiological, psychological and behaviour changes associated with growth and development

In each of the above stages, various physiological, psychological and behavioural changes take place. The changes that occur in each stage are explained in detail below:

Infancy

An infant (from the Latin word infans, meaning "unable to speak" or "speechless") is the very young offspring of a human or animal. When applied to humans, the term is usually considered synonymous with baby, but the latter is commonly applied to the young of any animal. When a human child learns to walk, the term toddler may be used instead.

Infancy is a period from 0-2 years. The child undergoes physical growth at a rapid rate, greater than he will never experience subsequently. It is interesting to know the changes that take place

in the first two years. Children at this stage are very active learners. During this period the baby's physiological processes become operative and fairly well adjusted.

The infancy stage is divided into three sub-categories: (i) neonatal, (ii) older baby, and (iii) toddler.

Neonatal

Neonatal stage is the stage from birth up to 4 weeks. New babies are also called neonates.

Physical and physiological changes

At this stage babies are helpless but can behave in a number of ways such as crying, moving their arms, legs and head. They can also stretch and make other movements. Baby movements are called reflexes. Examples of reflexes include moving arms, legs, and head, swallowing, and sucking.

Babies at this stage suck anything put in their mouths. They can also grasp objects put in their hands.

Neonates can see, but only a short distance of about 20cm. They can also hear, smell and feel. They spend most of their time sleeping.

The shape of a neonate changes significantly from birth to 4 months. Initially, the head and the abdomen are bigger compared to other body parts. The body becomes proportional as the baby grows up.

The immune system is immature and the baby depends on the immunity from his or her mother through breast–feeding.

The baby can sit with support and can respond to sounds, for example, smiling upon hearing her mother's voice.

The rate of heart beat at this stage is very high.

Behavioural and psychological changes: Babies at this stage express their feelings mainly through crying. They cry to show hunger, thirst, pain, tiredness, fear and discomfort such as wet nappies, cold, a lot of heat, and sickness.

Older baby

This is the stage from 6 to 12 months.

Physical and physiological changes

At six months a baby can completely control his/her head and sit without support. They can also roll over.

At 7 months the baby learns to crawl. The baby can use his or her hands to throw and point at things he or she wants using his or her index finger.

He or she can hold and drop objects and stand while holding things like tables or chairs.

Teething occurs at this period.

From 9 to 12 months the baby starts to walk.

At this stage the sight has improved and the baby can focus on far objects and can recognize people at a distance.

Behavioural and psychological changes: The baby responds to his or her own name and other words that are familiar to him. Social development also occurs at this period. For example, at 9 months, a baby can distinguish strangers from familiar people. At 1 year, he or she understands and obeys simple commands like “come”, “go”, “stop”, etc.

Toddler

This is the age between 1 to 3 years.

Physical and physiological changes

Brain develops by 90%.

The rate of heart beat is reduced to about 90-110 times per minute.

The child is able to control urination and defecation as urinary and anal sphincter control become possible.

Immune system becomes mature.

The baby can see everything that an adult can see.

The baby shows sense of colour.

All the 20 milk teeth appear by the age of 2.5 to 3 years

Hearing has developed well.

Psychological and behavioural changes

At 12 to 14 months, the child uses gestures to express his or her feelings, for example, raising arms when he or she wants to be picked up.

At 15 months, the child copies what adults do. For example, a child may imitate cooking by taking a spoon and stirring it in a bowl.

At 15 to 18 months, a child feeds himself or herself, addresses others with greetings, climbs onto furniture, for example bed or couch and speaks a few words.

At 19 to 24 months, a child likes to play with other children (socialization), he or she can dress and undress himself or herself, run or climb steps and wants to be independent at times. He or she throws a tantrum (angry) or possibly says "No". The child has also increased his or her vocabulary up to 50 words and starts toilet training. He or she mimics social behaviours such as holding and feeding a toy.

At 25 to 36 months, a child can play with other children and share playing toys, can speak in a sentence, is more independent, can differentiate boys from girls, shows preferences such as clothes and type of toys or games and knows how to play different games. Emotionally, children may feel jealousy, for example, towards a newborn baby. They also show fear for particular things for instance fear of some insects and fear of the dark or scary noise like thunder.

Childhood

Childhood is a period from 3 years to 12 years. The stage may be divided into three stages: (i) early childhood (ii) late childhood and (iii) pre-adolescence.

Early childhood

The early childhood years, 3-6 years of age, represent a remarkable period of physical and psychological developments. It is a period when true personality begins but physical development proceeds at a slower rate. Here children become more self sufficient, acquire language, become a part of the group, become more co-ordinated and obtain a higher degree of self control. At this stage, children go to kindergarten.

Physical and physiological changes

A child has good appetite and therefore grows rapidly. Good appetite is important as children at this age are very active and play a lot.

The child can identify up to five colours.

Motor coordination has developed well, and therefore the child can walk, jump and skip. Fine motor skills have also developed and the child can draw simple figures.

Psychological changes

The child is very curious and imaginative.

He or she understands right and wrong.

He or she is curious about sexuality.

The child can speak fluently, and can tell his or her age and name and a simple story.

Late childhood

The stage of late childhood starts from the 7th year and goes on till the 12th year. You have already gone through this period. Can you list some of the characteristics of this period?

During this period, physical growth continues at a lower rate but intellectual and emotional developments are rapid and very complex as the child moves from home to the outside world. He begins to acquire basic skills of formal learning and develops certain social activities. During the greater part of late childhood, the child's physical growth continues, but at a slower rate until it shows a sudden spurt as the child approaches adolescence. He is more attached to his peer groups and interested in social and group activities. During this period, school tasks contribute intellectual developments too. This is the age from 7 to 9 years. At this stage children are in primary school.

Physiological and physical and changes

Growth remains steady

Children are very active

Psychological and behavioural changes

The child can assume simple responsibilities like looking after the house when parents are not at home.

The child is very social and likes to socialize and belong to groups

He or she can help with household duties like washing dishes, setting the table and fetching water.

The child likes to associate with peers of similar interest.

This is the time children have friends and best friends. However they prefer friends of the same sex.

Children at this stage can listen to peer's opinion, but still value opinions of their parents

Pre-adolescence

This is the age from 10 and 11 years

Physical and physiological changes

Growth starts to increase

Appetite increases

Secondary sexual characteristics start to show, for example, growth of breasts and growth of pubic hair and armpit hair.

Psychological changes

Children still prefer friends of the same sex

They start to become independent from the family.

Children are very social and tend to value peers, opinions.

Services required to meet the needs of Children

The services required to meet the needs of a child can be categorized into two: essential or basic services, and supportive services. Essential or basic services are necessary for a baby's survival. Supportive services are services that will help a child to grow well socially, emotionally and mentally.

Supportive services include love, care and comfort, security, and training of habits and skills. Older children need to be disciplined, trained to be independent and useful to others and be responsible.Basic services include healthy food, warmth, shelter, clothing, protection against illness and injury, exercise and rest.

Healthy food:Well-balanced nutrition plays a major role in the growth of children. Healthy and well-balanced food should be given to children for good physical and mental growth.The improvement of strength, height, growth of muscle, bone tissue and body resistance is completely dependent on the diet that children eat. Children need balanced diet; they need to feed on food rich in proteins, vitamins, minerals, carbohydrates, fibre and fat in adequate proportions.Children are normally addicted to junk food, which only harms their young bodies. Bad food habits at this age can make children obese, more prone to heart diseases and other major health risks.Parents should make sure that their children are fed on energy-giving foods as well as vitamins, minerals and proteins. Children should not be provided with junk food which contains harmful cholesterol and fat that can impair the baby's health.

Protection against illness and injury:Some diseases and injuries may affect babies before they are born, at birth, or after birth. These may affect some parts of the body like the brain such that the child may become paralyzed or mentally retarded. Blindness, for instance may affect the development of physical and social capabilities of children. There are medical cases where diseases and injuries have caused a great deal of disabilities to children. Babies need to be immunized against some prevalent diseases such as tuberculosis, measles and polio.

Exercise and rest: A child's body also needs exercise. Exercise makes muscles strong. It also improves flexibility and makes the heart, lungs and other body parts work efficiently. Playing is a form of exercise. While the body needs exercise, it also needs rest. Muscles get tired when they are overworked. Sleep is a form of rest for babies. Children need enough sleep for proper growth.

Warmth: Babies need warmth for proper functioning of their bodies. If babies are kept in places that are too cold, they suffer from hypothermia. If kept in too hot environment, they may develop heat rush and dehydration, and may even die. Therefore, adequate warmth is important for proper growth and development of children.

Shelter: Children need a home where they can live, be nurtured, play, and be protected against harsh environmental conditions such as cold and rain. The home should be spacious, clean and safe.

Adolescence

Adolescent period follows late childhood and extends from the age of 13 to 19. Normally, girls reach adolescence earlier than boys of their age. Very often it is called the awkward age because of awkwardness, clumsiness and accompanying self consciousness which occurs frequently. During this time physical, mental, emotional and social developments are complete. It is considered as the last step in the long period of development which begins at the time of conception. By the end of adolescence, the individual is considered legally and socially matured. He is capable of living an independent life free from supervision and guidance.

Physical changes in an adolescent

During adolescence, the bodies of both girls and boys produce hormones which control many physical changes. These changes include the following:

Rapid growth in weight and height.

They become very energetic and active.

Hair grows in armpits and groins of both boys and girls. Boys also grow beards and some grow hair on their chests.

Girls start to get the menstrual flow (monthly period). Initially the flow is irregular, that is, it may not occur every month but after a few months it starts appearing every month.

The breasts also start to grow bigger in girls. The monthly period onset in girl marks the puberty stage which indicates that such as person is able to become a parent. This is why girls even below 12 years of age become pregnant because they produce mature ova.

Boy's sex organs enlarge and they occasionally emit some fluid from the penis at night (wet dreams). Wet dreams indicate that the boy has reached puberty and is capable of becoming a parent. Puberty onset is the beginning of adolescent stage.

Boys deepen their voice gradually while girl voices become mellow.

Some adolescents (boys or girls) develop pimples (acne) on the face but the pimples clear later on.

Psychological and behaviour changes at puberty

Adolescence is characterized by a number of physiological, psychological and behaviour changes.

The changes can be a cause of conflict on one hand and positive personality development on the other hand. For example, adolescents tend to view their friends and peers as more important and influential than their parents, guardians, teachers or elders.

Positive personality development includes opportunity to develop various social skills, such as empathy, sharing, leadership by peers and positive influences on an individual, for instance on academic motivation and performance.

When adolescence is not handled properly, negative influences such as experimentation with drugs, alcoholism and stealing may occur. Susceptibility to peer pressure increases during early adolescence but it peaks at around age 14 and declines thereafter.

Onset of puberty is also characterized by sexuality and sexual desire. Therefore education on reproductive health is very important at this stage as adolescents may find themselves contracting sexually transmitted diseases, HIV and early pregnancies.

Personal hygiene during adolescence

As stated above, adolescents are very active and energetic and are thus bound to sweat a lot. It is important that they bathe daily and change into clean clothes.

When bathing, one must pay extra attention to genitals, armpits and areas between the toes.

If the armpits sweat a lot, shave the pubic hair to reduce warmth and sweating. After bathing, apply deodorant to kill germs and prevent foul smell (there are deodorant for men too). For sweaty feet, clean between the toes, dry well and, if it can be afforded, dust the areas with talcum powder. The powder absorbs the sweat, prevents bad smell and athlete's foot.

In case acne strikes, it should not worry anybody. Avoid breaking the pimples but just: (i) keep the face clean; (ii) avoid applying oil creams; and (iii) avoid diet that contains a lot of oil.

With time, acne disappears on its own. Breaking the pimple can cause black spots or infection. If it worries the individual to a point of wishing to have it treated, it is wise to consult a doctor.

At this stage avoid harsh creams as they may react with the hormones and lead to damaged skin. Boys need to keep their beards shaved. Girls need to bathe more than once during the menstrual flow to avoid foul smell of blood. They need to wear sanitary towels to avoid staining their clothes with blood. The sanitary towels must be changed regularly to avoid development of foul smell and growth of germs. If commercial sanitary towels cannot be afforded, home-made pads can be prepared with cotton wool covered with gauze or just folding

Services required to meet the needs of adolescents.

Adolescents require healthy food for their growing bodies. They also require a peaceful home, security, emotional support, counselling, physical exercise and social skills that will help them resist temptations from peers and live a better and accepted lifestyle.

Adulthood

Adulthood starts at 20-60 years. It is the longest period of the life span. During this stage physical developments are fairly complete. But psychological adjustments continue throughout the entire stage. Choosing a life partner, establishing a family, becoming a useful and productive member, etc. are crucial during adulthood. One's personality and achievements are determined by the kind of experiences he has had during his early years of life. Adulthood can be categorized into early adulthood, middle adulthood and old age.

Early adulthood

Early adulthood (also called "emerging adulthood") is a stage of life between 20 and 40 years, when adolescents become more independent and explore different life possibilities. **Early adulthood** is also called **young adulthood** stage.

Changes during early adulthood

Growth has stopped, only maintenance of body parts, for example, repair of worn out cells takes place. A person may gain weight due to deposit of fats but not due to growth and development.

A this stage, people are in their best physical conditions, that is very strong, energetic, have good memory capacity, sharp senses, and stamina.

Performance of the body system is very high.

People at this stage are very ambitious and want to succeed. They work hard to meet their goals, for example to finish studies, get a decent job and / or start a family

They are selective in terms of choosing occupations or partners.

They have the desire to be socially independent.

Middle adulthood

Middle or late adulthood starts at 40 years and ends at 60 years. Initially, a person is still very strong and able to do tasks that require a lot of energy.

The performance of body stems is still high. Later, in the late forties or early fifties, the rate of deterioration becomes significant. The ability to do tasks that require a lot of energy and high speed decrease, sharpness of vision decreases and memory loss may occur.

Hair starts to turn grey, skin starts to loose elasticity. Women reach menopause and their desire to have sex is reduced.

Old Age

Old age starts from 60 years and over. It is considered as the final stage of the normal life span. During this period many physical, social, emotional and behavioural changes take place. Some men and women manifest signs which are associated with old age from their 60's onwards. These aging years demand a higher degree of emotional adjustments.

There are certain problems of adjustments such as physical and economic dependency, establishing new contacts and interests and activities to occupy increased leisure time. Psychological hazards during this stage include feelings of inferiority and inadequacy resulting from physical changes in life patterns, feeling of guilt about sitting idle and reduced income that necessitates changes in living patterns. Financial worries and ill health are common among this age.

As a person ages, various changes occurs in his or her body until her or she dies. Some of these changes are explained below:

Decreased blood flow to the brain and death of nerve cells.

The ability to focus on objects, smell and hear decreases.

Hair turns grey as a result of reduced production of hair pigment. The hair also becomes thinner. Some men may develop a bald head.

Kidney functioning slows down and the frequency of urination increases.

Digestion slows down especially for those who get poor diet.

Elasticity of the skin decreases. The skin gets looser and wrinkles develop.

Bones may become weak, especially for those who have been taking food with less calcium in young age.

Men delay getting an erection.

By the age of 70, about two thirds of taste buds in the mouth die, making a person fell like food is tasteless.

The above features do not apply to all aged people. Healthy life style during young age may delay occurrence of the above features and make a person lead a normal life even in older age.A healthy life style is achieved by eating healthy food, avoiding smoking, alcoholism, overeating, drug abuse, excessive noise, toxic chemicals, stress and inactivity.

Services required to meet the needs of the elderly

Older people need healthy food to strengthen their immune system and reduce the rate of body deterioration. For very old people, the food should be soft enough for them to chew, swallow and digest.

They also need clean and comfortable clothing and a place to sleep and do light physical exercise. They need love, care, and support. Love, care and support help old people to avoid anger, loneliness and stress.

Factors which Affect the Rate of Physical Deterioration of Human Body and Services Required to Meet the Needs of an Individual at each Stage

Outline factors which affect the rate of physical deterioration of human body and services required to meet the needs of an individual at each stage

Some people may live a happy, health life up to their old age and until they die. Others get very old while they are still young.

Some of the factors affecting the rate of deterioration of the human body are psychological. They include smoking, alcoholism, drug abuse, stress and inactivity.

Some other factors are environmental. They include poor diet, excessive noise, toxic chemicals and radiations, diseases, and infections. Other factors are genetical, for example, the Werner's syndrome.

Smoking: Smokers suffer more illnesses such as cancer than non-smokers. Smoking can cause lung cancer, cardiovascular disease, Chronic Obstructive Pulmonary Disease (COPD), and stroke. Smoking leads to premature balding, skin wrinkling and osteoporosis.Osteoporosis is a condition in which bones become thin and fragile, leading to fractures, stooped posture, breathing problems and back pain.

Alcoholism: The ability to metabolize alcohol decreases with age. Prolonged use of alcohol leads to damage of the central nervous system and brain and increases the risk of heart stroke and breast cancer for women.Alcoholism also increases the frequency of illnesses as it weakens the immune system and causes kidney failure and osteoporosis.

Drug abuse: Drug abuse weakens the immune system and causes premature aging. It thus reduces life span.

Stress: Stress may cause heart problems and high blood pressure. It also causes impairment of the immune system, thus making a person sick often. Other problems that may result from stress are failure to sleep (insomnia), fatigue, ulcers, headache and migraine.

Inactivity: Sedentary work and inactivity such as spending a long time watching TV or doing office work that involves sitting most of the time results in being overweight and its associated risks. It also shortens life span.People who are inactive have more chances of developing health problems such as obesity and high blood pressure than those who are active.

Poor diet: Poor diet includes both underfeeding and overfeeding. Underfeeding causes malnutrition which reduces life span. Overfeeding leads to obesity and diabetes. Obesity and diabetes cause premature aging.

Diseases and infections: Pathogens produce toxins that accelerate deterioration. They also deprive our bodies of the necessary nutrients needed for good health.

Chemicals and radiations: Some chemicals such as those found in cosmetics, medicines, insecticides, pesticides, foodstuffs and sprays may have adverse effects on the human body.These chemicals speed up deterioration or shorten life span. Some radiations, for example X-rays, may affect our lives by killing body cells or causing deadly diseases like cancer.

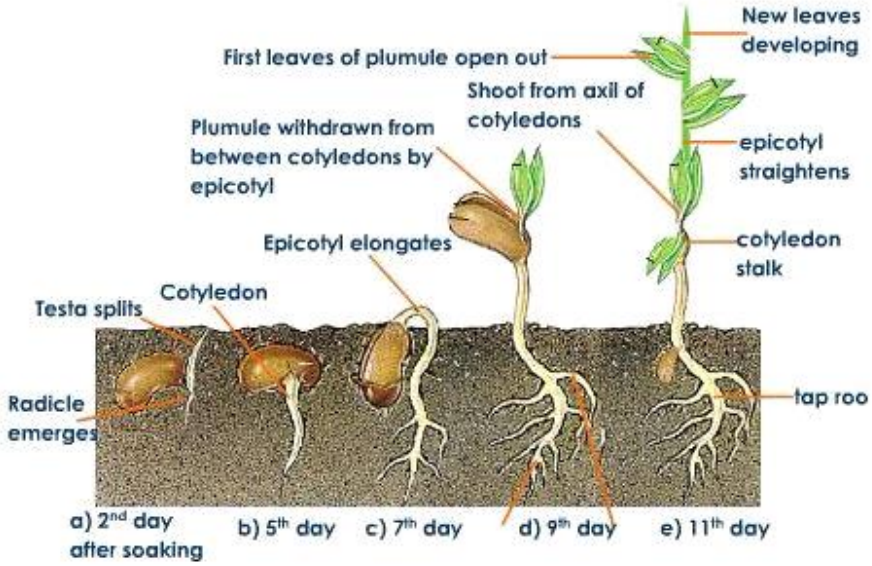
Werner's syndrome: Werner's syndrome is a very rare disease that causes rapid ageing after puberty, such that a 20 or 30 year old person may look several decades old. It is caused by gene mutation and is named after a German scientist, Otto Werner, who described the syndrome.

Growth in Flowering Plants

The concept of seed Germination

Explain the concept of seed germination

Germination is the process by which a plant grows from a seed. The most common example of germination is the sprouting of a seedling from a seed of an angiosperm or gymnosperm. Plant growth is said to be **localized**. In this case, growth is restricted to certain fixed regions like root tips and shoot tips. After the seed germinates, the embryo starts to grow as indicated in the figure below. The figure shows growth of a bean seedling between day 2 and 11.



Germination and growth of a bean seed

Changes which occur during seed Germination

Outline changes which occur during seed germination

There are changes that occur during seed germination. These are:

Seed absorb water and enlarge

Later on the testa bursts and the radicle emerges. The radicle continues to elongate and gives rise to many roots

As the radicle elongates, the plumule is curved. At this stage, young plant is called a seedling.

Accompanying these morphological changes are chemical changes which occur inside the seed. As the seed absorbs water the foods are hydrolyzed into soluble food. The starch stored in the cotyledons or endosperm is converted to sugar by action of diastase. In some seeds, lipase catalyzes the hydrolysis of fats to fatty acid and glycerol.

It is likely that glycerol is converted into sugars since it is not detected in germinating seeds. The proteolyctic enzymes catalyze the hydrolysis of proteins to amino acids.

During germination a lot of energy is required. This energy is derived from the stored food materials.It follows, therefore that as the seed germinates its weight decreases. This is because the stored food is being used. The decrease in weight continues until the seedling is capable of photosynthesizing.

Parts of a seed

A seed is a structure formed after the fertilization of an ovule. A seed contains the embryo of the plant. The embryo grows and develops into a mature plant which produces more seeds. The embryo is made up of the plumule, radicle and cotyledons. The plumule develops into a shoot. The radicle develops into a root. The cotyledons have nutrients which are utilized by the seed during germination.

Seeds have either one or two cotyledons. A seed with one cotyledon is called a monocotyledonous seed. Examples of monocotyledonous seeds are maize, rice, millet and wheat. A seed with two cotyledons is called a dicotyledonous seed. Examples are beans, peas and groundnuts

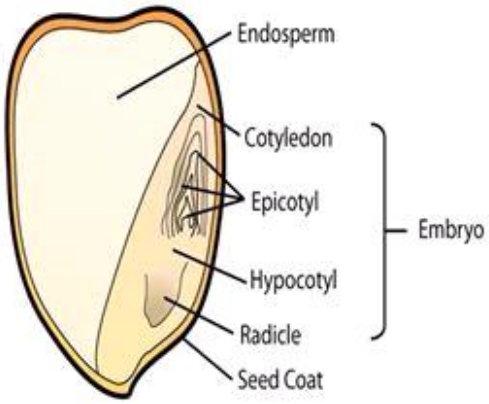
Seeds sometimes have additional nutrient tissues in form of the endosperm. The seed coat, also called testa, encloses the fertilized ovule. The testa has a pore called the micropyle. The micropyle allows water and air to get in and out of the seed.

On the testa is a scar called the hilum. The hilum marks the point of attachment to the funicle. The funicle attaches the seed to the placenta on the ovary wall.The plumule has small leaves. The leaves are the replica of natural leaves. A radicle is a replica of a mature root. The testa is hard and encloses the seed, hence protecting it.

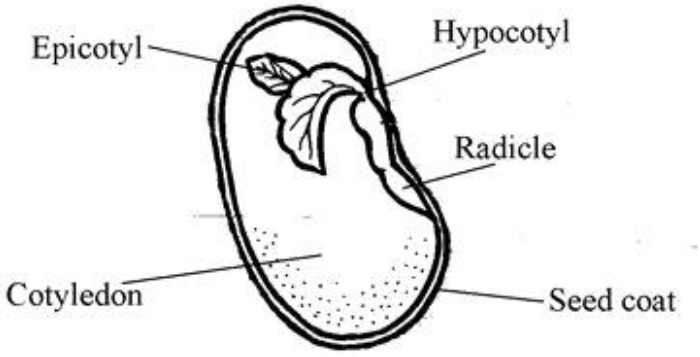
The figures below show the parts of a monocotyledonous seed (maize) and a dicotyledonous seed (bean).

Parts:

1. Seed coat
2. Endosperm
3. Embryo
   a. Cotyledon
   b. Epicotyl
   c. Hypocotyl
   d. Radicle



Maize seed (monocot)



Conditions necessary for seed Germination

Investigate conditions necessary for seed germination

Seeds require certain conditions for them to germinate. These conditions are water, oxygen, optimum temperature and light.

Water

Water is a solvent required for enzymatic activities. Water enters the seed through the micropyle. The water softens the testa thus allowing the seed to take in water. The osmotic pressure in the seed causes water to enter the seed by osmosis. Pressure is created in the swollen seed, rupturing the softened testa.

The seeds require water for the processes outlined below:

Activation of enzymes: When seeds are formed, most plants store a food reserve with the seed, such as starch, proteins, or oils. This food reserve provides nourishment to the growing embryo. When the seed imbibes water, hydrolytic enzymes are activated and break down these stored food resources into metabolically useful chemicals.

Most seeds need enough water to moisten them. The uptake leads to the swelling and the breaking of the seed coat, which enables the embryo to emerge from the cotyledon(s).

Water is used to dissolve food substances. The food needs to dissolve so as to diffuse or get transported to the growth parts of the embryo in the seed.

Water is needed for the development of the cell sap vacuoles. Large cell sap vacuoles contribute to the increase in the size of cells, hence, growth.

Oxygen

Oxygen is required by the germinating seed for metabolism. It is used in aerobic respiration, the main source of the seedling's energy until it grows leaves. Respiration produces energy for processes like cell division and transport of food to growing regions.

Oxygen diffuses into the seed through the micropyle. The softened testa later allows oxygen to diffuse directly into the tissues.

Optimum Temperature

Temperature affects cellular metabolic and growth rates. Seeds from different species and even seeds from the same plant germinate over a wide range of temperatures. Seeds often have a temperature range within which they will germinate, and they will not do so above or below this range. Many seeds germinate at temperatures slightly above 16-24 °C.

Temperature is an important requirement for activation of enzymes. The enzymes in the seed work best at optimum temperature since they are denatured by high temperatures and inhibited by extremely low temperatures.

Some seeds may require to be first exposed to low temperatures before they can germinate. This is usually the case in plants that grow in temperate climates. The seeds need to go through winter before the onset of spring when the seeds germinate.

Light

The requirement of light for germination varies from plant to plant. Some plants need darkness while others need light in varying degrees.

Light or darkness can be an environmental trigger for germination and is a type of physiological dormancy. Most seeds are not affected by light or darkness, but many seeds, including species

found in forest settings, will not germinate until an opening in the canopy allows sufficient light for growth of the seedling.

Types of seed germination

There are two types of seed germination namely, hypogeal germination and epigeal germination.

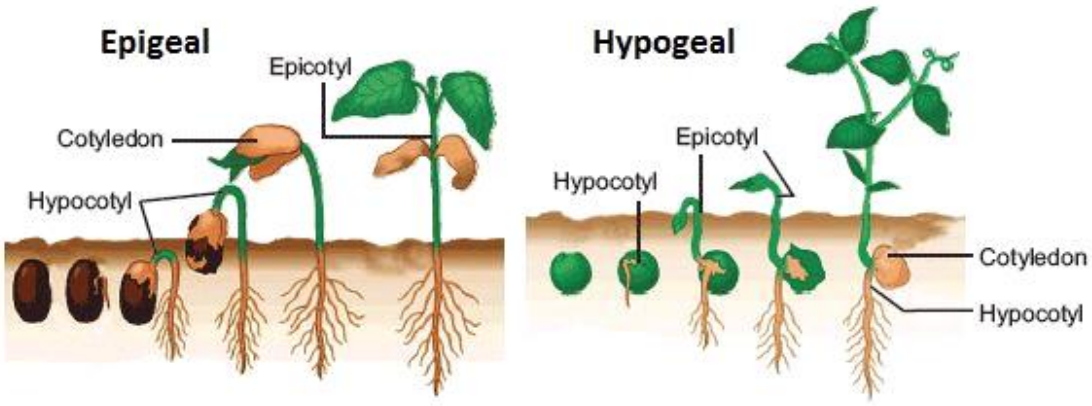
Epigeal germination

Epigeal germination is a type of germination in which the cotyledons are brought above the soil level. This type of germination is seen in many dicotyledonous plants, such as beans, sunflower, castor, bean, etc. Some monocotyledonous plants such as the onion also show epigeal germination.

In a dicotyledonous seed, the plumule and radicle are attached to the two cotyledons. The hypocotyl elongates rapidly raising the cotyledons into the air. The hypocotyl is the region of the stem beneath the cotyledons and directly above the young root of a seedling. The epicotyl is the region of the shoot of a seedling which is found above the cotyledon of an embryo.

The seed absorbs water and softens the testa. The cotyledons swell and rupture the testa. The radicle elongates and emerges through the seed coat. Roots develop from the radicle. The hypocoty elongates rapidly and develops a curvature. The curved part emerges above the soil. The hypocotyl eventually straightens, raising the cotyledons and the plumule above the soil. The cotyledons are also referred to as seed leaves.

The cotyledons enlarge and turn green to carry out photosynthesis. The epicotyl elongates thus increasing the height of the seedling. The first foliage leaves emerge. The cotyledons shrivel as the stored food materials are used up. The first foliage leaves enlarge and start carrying out photosynthesis.



Epigeal and hypogeal germination

Hypogeal germination

Hypogeal germination is a type of germination in which the cotyledons remain underground. It occurs in plants such as maize, pigeon peas, wheat, etc.

The part of the embryo that elongates is the epicotyl. The epicotyl elongates rapidly, raising the plumule above the soil. The cotyledons remain below the ground level.

The shoot is pushed through the soil particles. In maize, the plumule sheath, known as the coleoptile, protects the plumule. The coleotile grows towards light.

The foliage leaves emerge through the split end of the coleoptile. The foliage leaves carry out photosynthesis. The radicle is protected as it emerges through the maize grain by a sheath called coleorhizae.

Practical activities to demonstrate Epigeal and Hypogeal Germination

Carry out practical activities to demonstrate epigeal and hypogeal germination

Growth regions of a seedling

The growth of the radicle and the plumule causes the elongation of a seedling. A radicle develops and forms the roots, while a plumule develops and forms the shoot. The rate of growth can be measured at the tip of the root or shoot.

Cells at the root and shoot apices have a high capacity to divide. The dividing cells are called meristematic cells. The cells make up a tissue called the apical meristem. These cells rapidly undergo mitosis, thus enlarging and giving rise to more cells.

The very cells increase the size of the shoots and roots. The cells differentiate to form tissues that carry out specific functions.

The plant organs elongate, resulting in growth at the root and shoot apices. This type of growth is known as primary growth.

The meristematic tissue at the shoot apex actively divides, leading to the elongation of the shoot. The meristematic tissue also gives rise to leaves. Leaf primordia, from which the leaves develop, occur at the nodes of the shoots.

The part of a stem between one node and the next is called the internode. The axillary bud has meristematic tissue known as the intercalary meristem. The meristem tissue brings about internode elongation.

How a plant grows from a seed

TOPIC 2 GENETICS

Concept of Genetics

The concept of the Genetics

Explain the concept of the genetics

Genetics is the study of heredity and variations in organism. Through this statement there are two common words that are heredity and variation.

Heredity is the passing on of characteristics from parents to the off spring.

Variation is the observable differences in organisms from the same species.

The hereditary characteristics are passed from parents to their offspring through distinct units called genes.

Genes are hereditary materials or factors, which determine a specific characteristic or trait in an organism.

Common terms used in Genetics

State common terms used in genetics

First filial generation (F1)

This is arising from the crossing of two pure breeds

Second filial generation (F2)

This is the generation obtained by crossing individuals of the first filial generation.

Genotype

This is the genetic makeup of an organism or an individual

Phenotype

This is the outward appearance determined by a gene

Haploidy (n)

Having one set of unpaired chromosomes in the nucleus

Diploidy (2n)

Having two sets of homologous (similar) chromosomes in the nucleus

Alleles

It is the alternative number of genes in the nucleus or in the same position

Homozygosity

The state of possessing two identical forms of a particular gene, one inherited from each parent. For example, a girl who is homozygous forcystic fibrosis(CF) received the cystic fibrosis gene from both of her parents and therefore she has cystic fibrosis.

Heterozygosity

Thestateofbeingheterozygous;havingtwodifferentallelesofthesamegene

Dominance

This is a condition where an allele can express itself in the presences of other alleles. Example: 'Tt' where 'T' is the dominant that expresses its effect in the presence of 't'.

Recessiveness

A condition where an allele can only express itself when they are in homozygous form but does not express its effect on the presence of other alleles.

Mutation

A sudden random change in the genetic make up of a cell, causing it and all cells derived from it to differ from normal cells.

Mutagen

This is an agent capable of increasing the rate of mutation in an organism like formaldehyde and nitrous acid.

Selfing

It is the crossing offspring of the same pair of parents.

Genetics Materials

The concept of Genetics Materials

Explain the concept of genetics Materials

Hereditory characteristics are passed from parents to their offspring through distinct units called genes.There are a lot of genes in an organism's body. Genes are arranged in a linear manner, making chromosomes.

Chromosomes are thread like structures found in the nuclei of all body cells. Gene is made up of chemical substances called Nucleic acid.

There are two types of nucleic acids found in cells, these are:

Deoxyribonucleic acid (DNA)

Ribonucleic acid (RNA)

These acids are made up of building blocks called nucleotides. Each nucleotide consists of three molecules linked together, that is a pentose sugar, phosphoric acid and organic base.

The structure and composition of Genetics Materials (Deoxyribonucleic Acid and Ribonucleic Acid)

Describe the structure and composition of genetics materials (Deoxyribonucleic Acid and Ribonucleic Acid)

DNA is called the "molecule of life". This is because it determines the physical and behavioural characteristics of an organism. The DNA determines example the colour of your hair, eyes, skin, ears and nose, height, ability or inability to roll the tongue all.

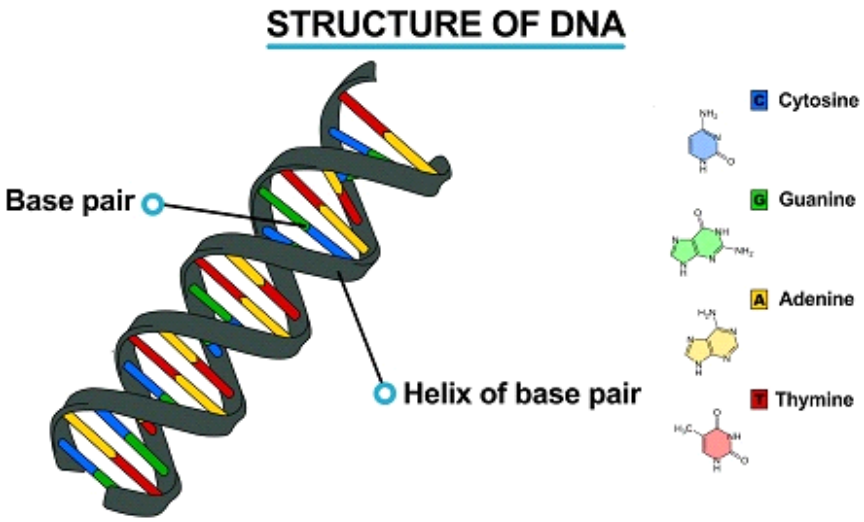
he DNA is made up of many nucleotides that make the double stranded.

STRUCTURE OF DNA

DNA is a double stranded helical (spiral) molecular chain of a nucleic found within the nucleus of a cell.By “double stranded helical” it means that the DNA consists of two strands, which twist around each other in a spiral fashion.

The DNA is made up of many nucleotides forming a polynucleotide chain. Polynucleotide means many nucleotides

The polynucleotide chain runs in the opposite direction. Each chain is joined to the other by pairs of bases. There are four bases namely Guanine (G), Cytosine ©, Adenine (A) and Thymine (T)



Note:

Guanine and adenine are collectively called purines while cytosine and thymine are collectively called pyrimidine

Guanine pairs with cytosine and adenine pairs with thymine.DNA plays a key role in inheritance because it replicates itself during mitosis and meiosis. DNA also undergoes changes and has genetic information the characteristics of a species.

RNA

The chromosomes replicate during cell division. The replication occurs during mitotic and meiosis cell divisions

The chromosomes determine the type of protein synthesized. The genes determine the actual characteristics of the organisms. In protein synthesis deoxyribonucleic acid acts as a template for the formation of ribonucleic acid (RNA).

STRUCTURE OF RNA

RNA consists of only a single strand of polynucleotide. The polynucleotide is made up of many nucleotides. Each nucleotide consists of a nucleobase, ribose sugar and phosphate group.The RNA sugar is ribose and not deoxyribose. Its nucleotides contain only one of four bases that are:

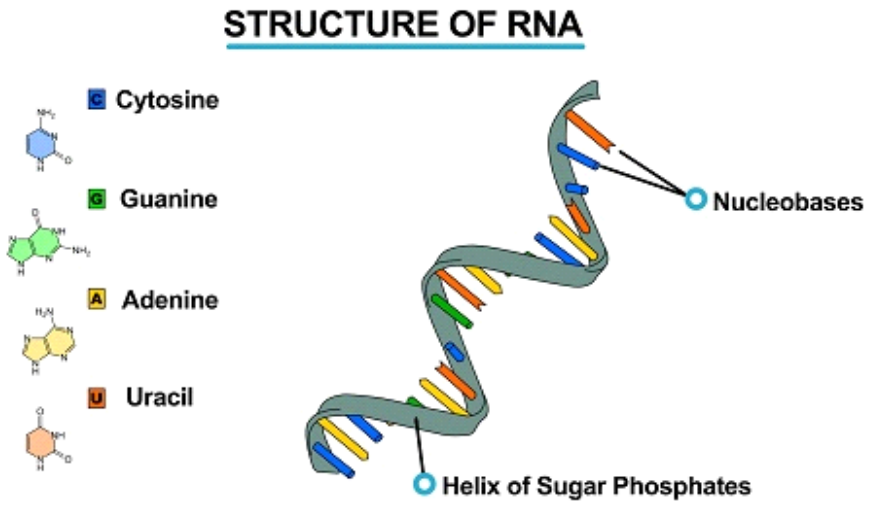
Guanine (G)

Cytosine (C)

Adenine (A)

Uracyl (U)

NB: Uracyl replaces the thymine of DNA. So in this the adenine can pair with uracil while the Guanine pairs with thymine.



The RNA is involved in protein synthesis. There are various types of RNA:

Messenger (mRNA)

Transfer (tRNA)

Ribosomal (rRNA)

Difference between Deoxyribonucleic Acid (DNA) and Ribonucleic Acid (RNA)

Differentiate Deoxyribonucleic Acid (DNA) from Ribonucleic Acid (RNA)

DNA versus RNA comparison chart

	DNA	**RNA**

Stands For	DeoxyriboNucleicAcid.	RiboNucleicAcid.
Definition	A nucleic acid that contains the genetic instructions used in the development and functioning of all modern living organisms. DNA's genes are expressed, or manifested, through the proteins that its nucleotides produce with the help of RNA.	Theinformation found in DNA determines which traits are to be created, activated, or deactivated, while the various forms of RNA do the work.
Function	The blueprint of biological guidelines that a living organism must follow to exist and remain functional. Medium of long-term, stable storage and transmission of genetic information.	Helps carry out DNA's blueprint guidelines. Transfers genetic code needed for the creation of proteins from the nucleus to the ribosome.
Structure	Double-stranded. It has two nucleotide strands which consist of its phosphate group, five-carbon sugar (the stable 2-deoxyribose), and four nitrogen-containing nucleobases: adenine, thymine, cytosine, and guanine.	Single-stranded. Like DNA, RNA is composed of its phosphate group, five-carbon sugar (the less stable ribose), and four nitrogen-containing nucleobases: adenine, uracil (not thymine), guanine, and cytosine.
Base Pairing	Adenine links to thymine (A-T) and cytosine links to guanine (C-G).	Adenine links to uracil (A-U) and cytosine links to guanine (C-G).
Location	DNA is found in the nucleus of a cell and in mitochondria.	Depending on the type of RNA, this molecule is found in a cell's nucleus, its cytoplasm, and its ribosome.

Stability	Deoxyribose sugar in DNA is less reactive because of C-H bonds. Stable in alkaline conditions. DNA has smaller grooves, which makes it harder for enzymes to "attack."	Ribose sugar is more reactive because of C-OH (hydroxyl) bonds. Not stable in alkaline conditions. RNA has larger grooves, which makes it easier to be "attacked" by enzymes.
Propagation	DNA is self-replicating.	RNA is synthesized from DNA when needed.
Unique Features	The helix geometry of DNA is of B-Form. DNA is protected in the nucleus, as it is tightly packed. DNA can be damaged by exposure to ultra-violet rays.	The helix geometry of RNA is of A-Form. RNA strands are continually made, broken down and reused. RNA is more resistant to damage by Ultra-violet rays.

Principle of Inheritance, Concept of Inheritance

The Concept of Inheritance

Explain the concept of inheritance

Gregor John Mendel advanced the principles of inheritance. In 1856 – 1863 Mendel grew and tested some 29,000-pea plants. From these studies, he formulated the law of segregation and the law of assortment.

After his work on peas, Mendel began to experiment with honeybees. However, he failed to produce a clear picture of their heredity because of difficulties in controlling the mating behaviour of queen bees.Mendes works was largely criticized and generally rejected during his lifetime. It was only after his death that his work gained broad recognition. He is now considered the father of modern genetics, Mendel diedMendel died on January 6th, 1884.

Mendel chose the garden peas because of the following reasons:

- It is self-pollinating but can be cross-pollinated

- It matures very fast
- It produces many seeds and hence many off springs
- It has several physical properties

Some of the characteristics that be studies were:

- Height of the stem-tall or dwarfs
- Texture of the seed coat – smooth or wrinkled
- Colour of flowers – purple or white
- Colour of pods – green or yellow
- Position of flowers – axial or terminal

Mendelian Inheritance

Mendel's First Law of Inheritance

State Mendel's first law of inheritance

FIRST LAW

This law is also called Mendel's first law of inheritance or law of segregation. The law states, "An organism's characteristics are determined by internal factors which occur in pair". Only one of the factors can be contained in a single gamete.

In modern terms this means that genes occurring in pairs control the characteristics of an organism but only one gene can be carried in a single gamete.

There are four main concepts in this law:

- Genes can exist in more than one form
- An organism inherits two alternative form of a gene for a particular trait, one from each parent
- During the production of gametes pair of alleles separate. Thus each gamete has one allele for each trait.
- When the two alleles in a pair are different one is dominant while the other is recessive. This condition is called complete dominance.

When inheritance of one pair of characteristics is studied at a time it is called Monohybrid inheritance.

Monohybrid Crosses and Interpretation of their Results of Crosses and Ratios

Illustrate monohybrid crosses and interpret their results of crosses and ratios

MONOHYBRID INHERITANCE

This is an inheritance of one pair of characteristic or trait at a time.

Example 1:

Mendel selected tall plants and self pollinated them.

Consider below

chart Tall x Tall

His results were that all trees were tall.

Also he cross-pollinated the pure breed tall plant and pure breed short (dwarf) plants. Consider belowchart Tall x dwarf

All plants produced are normal and also are known as the first filial generation (F1).Hence he concluded that the tallness is said to be dominant which the gene for dwarfness is said to be recessive in the garden pea. Because the gene of dwarf are masked by the gene for tallness.Hybrid is an offspring of a cross-between parents showing unlike characteristics.Test Cross (Back cross) this is the cross that involves off springs of two different pure lines.

Interpretation of data from Monohybrid Experiments to Demonstrate Mendel's First Law of Inheritance

Interpret data from monohybrid experiments to demonstrate mendel's first law of inheritance

Some conditions in human follow Mendelian monohybrid inheritance. Example, a condition that is associated with a simple pair of alleles and are inherited in Mendelian fashion

Examples of such conditions are:

Albinism

Sickle Cell anemia

Rhesus blood group

Haemophilia

Achondroplasia

Patterns of Inheritance that Follow Mendel's First Law

Illustrate patterns of inheritance that follow mendel's first law

DIHYBRID INHERITANCE

Mendel continued to study the inheritance of two pairs of characteristics. This inheritance is known as dihybrid cross.Dihybrid Cross is the inheritance of two characteristics in which each is controlled by a different gene, different locus.

Examples of two characteristics to an organism:

Tall with purple flower

Dwarf with white flower

From the above experiment Mendel made the following conclusions:

Two phenotypes in the ration 9:3:3:1 resembled one or other of the parent

Two phenotypes did not resemble any of the parents' phenotypes but instead had combined the characteristics of both parents

Ratio of tall to dwarf plants was 3:1 and that of purple flowered plant was 3:1

Non-Mendelism Inheritance

Concepts of Incomplete Dominance and Co-dominance

Explain concepts of incomplete dominance and Co-dominance

Not all inheritance follows Mendelian fashion. Mendel only considered characteristics that were determined by single genes with two alleles in which one is dominant and the other recessive. Later research showed that in some alleles neither one is dominant over the other. That condition is known as co-dominance or incomplete dominance.

Incomplete Dominance

This is the condition in which no allele is dominant or recessive compared to the otherExample when red and white flowered varies of the four o'clock plant are crossed, all the plant of the F1 generation produce pink flowers.

Complete dominance

Complete Dominance is a condition in which a dominant gene completely masks recessive gene. Example: Homozygous tall plant crossed with the homozygous short/dwarf plant. chart showing Tall x Dwarf.

Patterns of Inheritance that deviates from Mendel's First Law of Inheritance

Illustrate patterns of inheritance that deviates from mendel's first law of inheritance

NON-MENDEL INHERITANCE

Not all inheritance follows Mendelian fashion. Mendel only considered characteristics that were determined by single genes with two alleles in which one is dominant and the other recessive. Later research showed that in some alleles neither one is dominant over the other. That condition is known as co-dominance or incomplete dominance.

INCOMPLETE DOMINANCE

This is the condition in which no allele is dominant or recessive compared to the other

Example when red and white flowered varies of the four o'clock plant are crossed, all the plant of the F1 generation produce pink flowers.

Consider belowchart Red x White

INHERITANCE OF ABO BLOOD GROUPS

The entire human population falls under four main blood group that are –A, B, AB and O.Allele A and B are condomint white allele O is recessive to both A and B.

Example: parents with heterozygous blood group A and B have off spring with blood group A, B, AB and O as illustrated in the following cross.

Phenotype Blood group A x Blood group Bchart

Sex Determination and Inheritance

The Mechanism of Sex Determination and Inheritance

Describe the mechanism of sex determination and inheritance

Human beings have 46 chromosomes (23 pairs of homologous chromosome). In every body cell of these, two are sex chromosomes while 44 are referred to as Autosome.

By definition:

Sex determination refers to the interpretation between male sex and female sex.

A diagrammatical representation of human sex determination is shown below.chart showing cross Male x Female

The Concept of Sex Linked, Sex Limited and Sex Influenced Characters

Explain the concept of sex linked, sex Limited and sex influenced characters

This refers to the tendency in which one chromosome carries other genes.

Unlike other chromosomes in which each of the homologous chromosomes carries gene for the same characteristics, X and Y do not carry the same gene.

Consequences of Sex Preference and Sex Selection

Explain consequences of sex preference and sex selection

Sex preference and selection is the tendency of people to like one type of sex more than the other. This tendency is very common in African countries and some parts of Asia.

Some people in a family prefer having boys than girls while others prefer girls to boys. Those who prefer boys do so in a belief that boys will perpetuate the linage and take care of the parents when females are living far away with their husbands. Those who prefer girls argue that, girls are kind and merciful; therefore they can take care of their parents in old age.

The sex preference and selection is influenced by a number of socio-cultural factors. Some of the factors include the following:

Manpower Generation: Some societies prefer boys to girls because they generate wealth upon getting married. A family will get a lot of cattle or money as bridal price.

Generation and protection of wealth: Some societies prefer girls more than boys because girls will prefer to have more sons than girls so that they can somehow benefit indirectly through their son.

Land ownership In some societies a woman cannot own land thus prefers more sons than daughters because they can benefit from the sons.

Variation Among Organisms

The concept of Variation

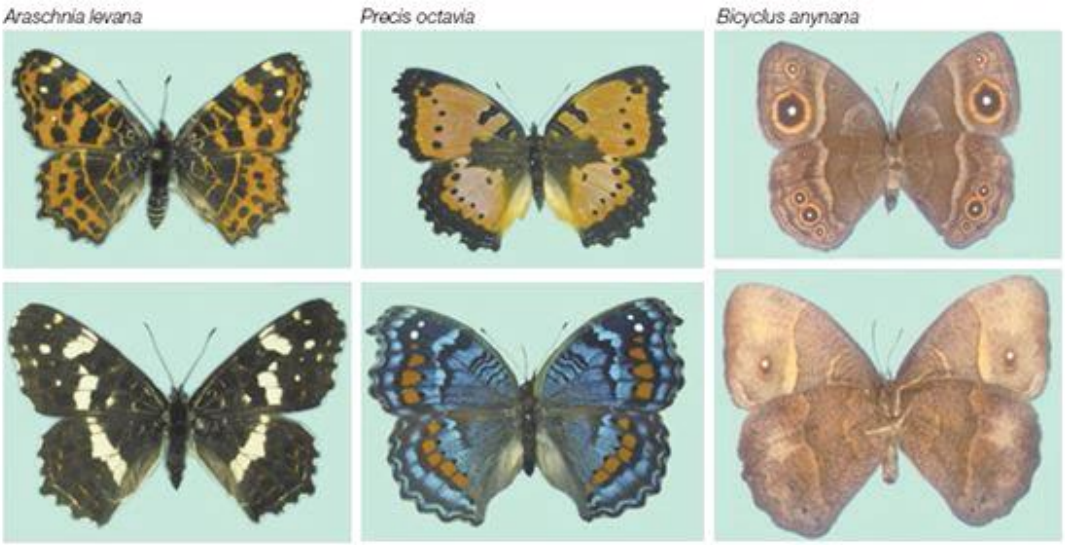
Explain the concept of variation

Variation, in biology, refers to any difference between cells, individual organisms, or groups of organisms of any species caused either by genetic differences (genotypic variation) or by the effect of environmental factors on the expression of the genetic potentials (phenotypic variation). Variation may be shown in physical appearance, metabolism, fertility, mode of reproduction, behaviour, learning and mental ability, and other obvious or measurable characters. If you consider almost any characteristic, you will find differences between various people (or other animals or plants) in a population.

Variations among Organisms

Identify variations among organisms

Genetic variation describes naturally occurring genetic differences among individuals of the same species. This variation permits flexibility and survival of a population in the face of changing environmental circumstances. Consequently, genetic variation is often considered an advantage, as it is a form of preparation for the unexpected. Variation between different species is always greater than the variation within a species.



Genetic variations are caused by differences in number or structure of chromosomes or by differences in the genes carried by the chromosomes. Eye colour, body form, and disease resistance are genotypic variations. A variation cannot be identified as genotypic by observation of the organism. Breeding experiments must be performed under controlled environmental conditions to determine whether or not the alteration is inheritable.

Environmentally caused variations may result from one factor or the combined effects of several factors, such as climate, food supply, and actions of other organisms. These variations do not involve any hereditary alteration and in general are not transmitted to future generations.

The Meaning of Continuous and Discontinuous Variations

Give the meaning of continuous and discontinuous variations

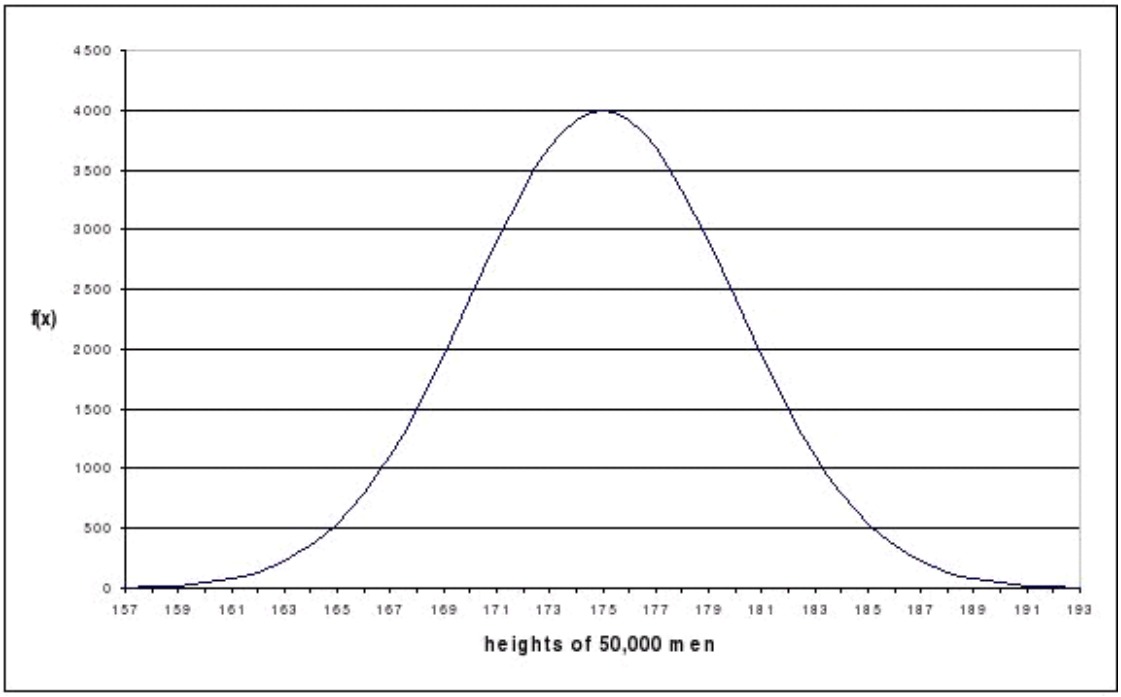
Types of variation

Variations are classified either as **continuous, or quantitative** (smoothly grading between two extremes, with the majority of individuals at the centre, as height in human populations); or as **discontinuous, or qualitative** (composed of well-defined classes, as blood groups in man). A discontinuous variation with several classes, none of which is very small, is known as a polymorphic variation. The separation of most higher organisms into males and females and the

occurrence of several forms of a butterfly of the same species, each coloured to blend with a different vegetation, are examples of polymorphic variation.

Continuous variation

This type of variation exhibits a wide range of differences for the same characteristics, from one extreme end to the other. Characteristics showing continuous variation vary in a general way, with a broad range, and many intermediate values between the extremes. As a matter of fact, if you consider a large enough sample from a population, perhaps plotting frequency as a histogram or as a frequency polygon, you will find that most of the values are close to the average (mean), and extreme values are actually rather rare. Examples of continuous variations in human beings include weight, height and complexion. Height is an example of continuous variation. People vary in height from very short to very tall, with many intermediate heights.



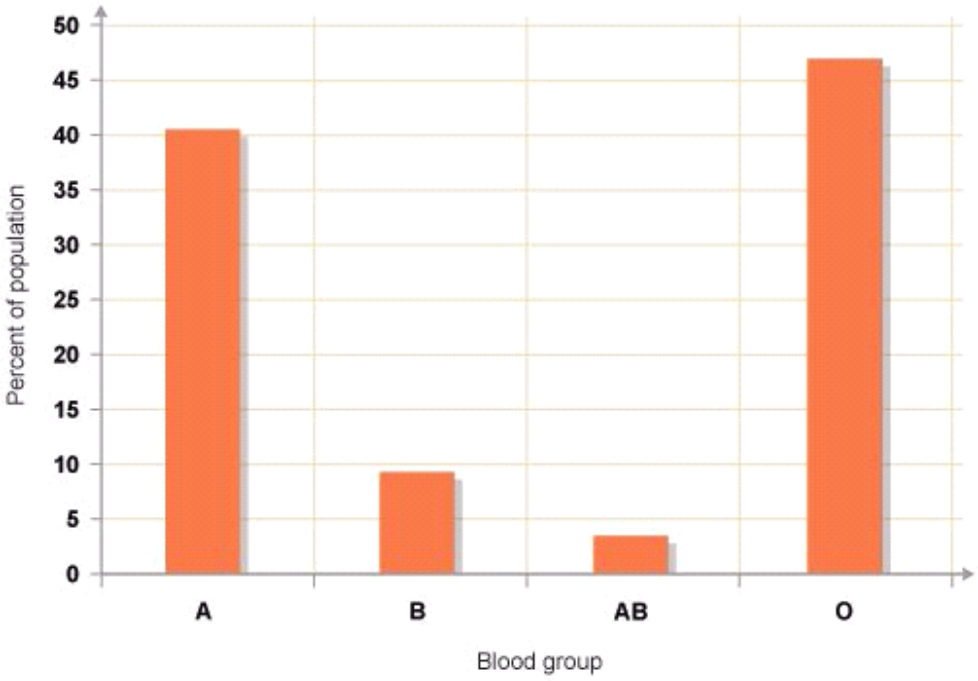
A frequency polygon for continuous variation

Discontinuous variation

Discontinuous variation is a type of variation that shows sharp differences among individuals of a species, with no intermediate forms.

Individuals fall into a number of distinct classes or categories. This is based on features that cannot be measured across a complete range. A person either has the characteristic or not. There is no intermediate condition.

The ability to roll the tongue (one is either tongue roller or non tongue roller), fingerprints, sex (one is either male or female) and the ABO blood group system where one can only have blood group A, B, AB or O. and blood groups. In plants, a pawpaw tree is either male or female. These characteristics can be explained much more easily by simple rules of genetics and are less likely to be affected by other factors. Discontinuous variations are unchangeable and unaffected by the external environment.



Discontinuous variation of blood groups

Difference between Continuous and Discontinuous Variation

Differentiate continuous from discontinuous variation

Some of the major differences between continuous and discontinuous variations in inheritance are as follows:

Continuous Variations:

The variations fluctuate around an average or mean of species.

Direction of continuous variations is predictable.

They are already present in the population.

Continuous variations are formed due to chance segregation of chromosomes during gamete formation, crossing over and chance pairing during fertilization.

They can increase adaptability of the race but cannot form new species.

Continuous variations are connected with the mean or average of the species by intermediate stages.

The continuous variations are also called fluctuations.

When represented graphically, continuous variations give a smooth bell shaped curve.

They are very common.

Continuous variations do not disturb the genetic system.

Discontinuous Variations:

A mean or average is absent in discontinuous variations.

The direction of discontinuous variations is unpredictable.

Discontinuous variations are new variations though similar variations might have occurred previously.

Discontinuous variations are produced by changes in genome or genes.

Discontinuous variations are the fountain head of continuous variations as well as evolution

These variations are not connected with the parental type by intermediate stages.

Discontinuous variations are also known as mutations or sports.

A curve is not produced when discontinuous variations are represented graphically.

These variations appear occasionally.

They disturb the genetic system of the organism.

Causes of Variation among Organisms

Explain causes of variation among organisms

Variation can be due to inheritance, and also to environmental factors such as climate and diet.

Genetic causes of variation (inherited variation)

Some variation within a species is inherited. Variation in a characteristic that is a result of genetic inheritance from the parents is called inherited variation. Each egg cell and each sperm cell contains half of the genetic information needed for an individual. When these join at fertilisation a new cell is formed with all the genetic information needed for an individual.

Examples of inherited characters in humans include eye colour, hair colour, skin colour and lobed or lobeless ears.

Gender is inherited variation too, because whether you are male or female is a result of the genes you inherited from your parents.

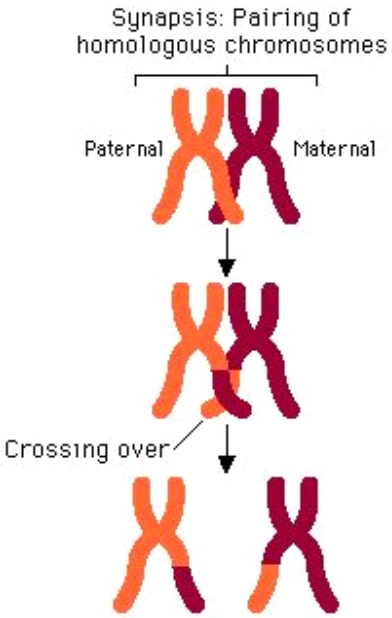
Genetic variation can be caused by mutation (which can create entirely new alleles in a population), random mating, random fertilization, and recombination between homologous chromosomes during meiosis (which reshuffles alleles within an organism's offspring). Some of these variation causes are explained in detail below:

Independent assortment of homologous chromosomes

This occurs at the time of gamete formation. At the time of gamete formation during meiosis, the parental chromosomes separate at random hence forming different gametes with different chromosomes. This independent assortment gives a wide variety of different gametes and hence individuals.

Crossing-over

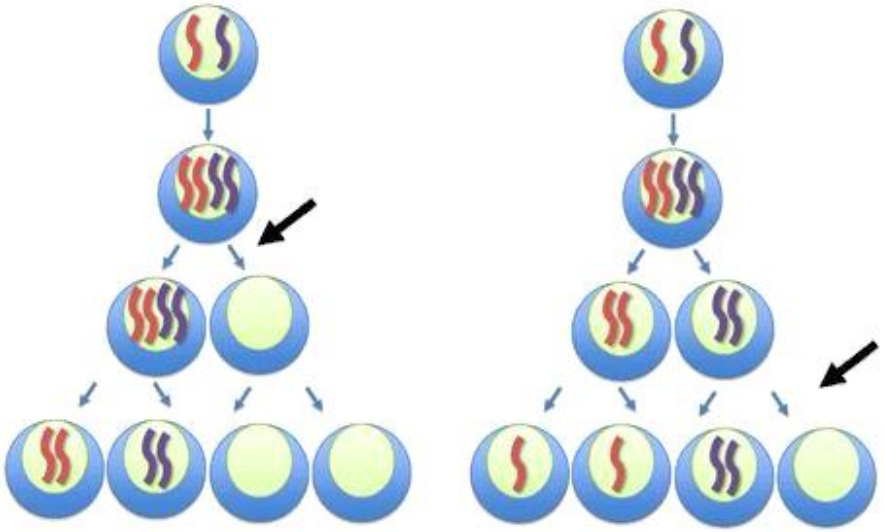
Chromosomal crossover (or crossing over) is the exchange of genetic material between homologous chromosomes that results in recombinant chromosomes during sexual reproduction. Crossing over and random segregation during meiosis can result in the production of new alleles or new combinations of alleles. Portions of paired chromosomes may be exchanged to form new chromosomal and gene combinations in gametes resulting into new trait combinations in offspring.



The process of crossing over

Non-disjunction

Non-disjunction results into doubling of the chromosome number due to failure of chromosomes to segregate during meiosis. This leads to increase in cell size and subsequent increase in size of various parts of the organism, hence variation.



Non disjunction process

Random fertilization

Random fertilization that results during the fusion of the gametes also contributes to variation. Gametes are the egg and sperm, or pollen, produced by meiosis. Each gamete has a unique set of combination of genes. A male gamete can fertilize any of the female gametes. The fertilization between a male gamete and a female gamete occurs randomly in the fallopian tube. As a result, each zygote is unique and hence variation occurs due to the different combination of genes from the male and female gamete.

The random fusion of gametes is a source of genetic variation in offspring (with the same parents). For example, a litter of puppies or kittens sired (bred) by the same father will show variation between individuals as shown bellow.

Variation among puppies sired by the same father

Random mating

Random mating involves individuals pairing by chance, not according to their genotypes or phenotypes. Random mating is a source of variation in a population. For example, a population in which mating only occur between organisms of similar phenotypes, such as red beetles mating with red beetles and yellow beetles mating with yellow beetles, will tend to show less variation than a population where crosses are random. For example, red beetles mating with yellow beetles.

Mutations

Mutations are sudden and permanent changes in the genes and chromosomes which are then passed on from cell to cell during mitosis. Such changed genes or chromosomes will produce offspring that differ from parents.

Environmental causes of variation

Characteristics of animal and plant species can be affected by factors such as climate, diet, accidents, water, temperature, light, diseases, degree of acidity, soils nutrients, culture and lifestyle. For example, if you eat too much you will become heavier, and if you eat too little you will become lighter. A plant in the shade of a big tree will grow taller as it tries to reach more light. Such variations are produced in the body (somatic) cells and not in the sex cells hence cannot be inherited.

Variation caused by the surroundings is called environmental variation. Here are some other examples of features that show environmental variation:

Your language and religion

Flower colour in hydrangeas - these plants produce blue flowers in acidic soil and pink flowers in alkaline soil

Genetic Disorders

The meaning of Genetic Disorders

Give the meaning of genetic disorders

This refers to an abnormality, which results from problems in the genes of an organism, and it is inherited. This means that the genetic disorder is caused by the change in the gene or chromosomes due to an error in the person's genetic materials.

OR

Genetic disorders are malfunctioning of the body's physiological mechanisms due to changes on gene or chromosomes; for example the change in number of chromosomes from 46 to 47 chromosomes or below that hence leading to genetic disorders.

Examples of Genetic Disorders

Cite examples of genetic disorders

Genetic disorders includes:

Down's Syndrome or Mongolism/Mongolia

Turner Syndrome

Super male and Super female

Haemophilia

Colour blindness

NOTE: The changes in the genes and chromosomes may be caused by different factors, which lead to genetic disorder. The sudden change in genetic materials of the cell that may cause it to differ from other cells is known as mutation.

The Causes and Effects of Genetic Disorders

Explain the causes and effects of genetic disorders

An organism is affected by mutation, which occurs naturally at a low rate. A number of factors may contribute to mutation. Such factors include various chemicals and radiation example X-rays. Mutation can be due to a change in gene itself i.e. this is called point mutation only or in the arrangement of gene chromosome. Other causes of mutation include addition or loss of chromosomes and duplication of genes.

There are two types of mutation including chromosomal mutation and gene mutation. Both leads to the genetic disorder is to lead to change in gene and chromosome. Chromosomal mutation leads to genetic disorder like Down's syndrome, Turner Syndrome, Klinefelter's Syndrome. It

affects the appearance or the number of chromosomes. Gene mutation leads to genetic disorders like Haemophilia and Colour blindness, which affects the genes.

Down's syndrome or Mongolism:

This is a chromosomal abnormality in which there are three copies of chromosome number 21 instead of the usual 2. The person with Down's syndrome therefore has 47 chromosomes in his/her body cells. The affected individuals have a short broad face, slanted eyes, short fingers and weak muscles. Such individuals are usually mentally retarded.

The presence of the extra chromosome on chromosome 21 is known as trisomy. The extra chromosome on chromosome 21 is due to its failure to separate during meiosis. This is known as non-disjunction. This non-disjunction occurs when homologous chromosome fail to separate in meiosis II of the egg. Therefore after the fertilization, chromosome 21 will contain 3 (i.e. the 2 which failed to separate plus the one from the father) instead of normal two (i.e. each from one parent). In some few cases non-disjunction may occur in the father's sperm.

Causes of Down's syndrome

An extra chromosome on chromosome 21, thus making three instead of two, causes this disorder. The extra chromosome on chromosome 21 is caused by failure to separate during meiosis.

Effects of Down's syndrome

People with down's syndrome are very susceptible to diseases including heart diseases. They thus die young, mostly not more than 30 years. They may also suffer discrimination in those societies that consider it as a curse or something very unusual.

Turner's syndrome (XO)

This is a genetic disorder of female (women) caused by absence of second sex chromosome. Such women are XO, rather than the normal XX chromosome. In this disorder there are only 45 chromosomes, the female lacks secondary sexual feature, small uterus, the internal genitals never mature and therefore she is sterile. This disorder is characterized by lack of ovaries and menstrual cycle.

Causes of Turner's syndrome

This genetic disorder is caused by absence of X chromosome in normal XX chromosome. This occurs when the second X chromosome lacks i.e. make XO instead of normal XX chromosome.

Effects of Turner's syndrome

The women who suffer from Turner's syndrome are abnormally short; their ovaries usually do not develop and hence are infertile.

They may also suffer mental abnormalities, which may lead to difficulty in learning

Missing one copy of this gene causes short stature and skeletal abnormalities in women with Turner's syndrome. This is due to the researchers who identified one gene called SHOX that is important for bone development and growth, hence when missing it will cause skeletal abnormalities.

Super Male and Super Female

This is the genetic disorder caused by the non-disjunction of sex chromosomes, leading to a male having an extra Y chromosome (XYY) that is a super male. Also a female having an extra X chromosome (XXX) that is a super female; hence both male and female have 47 chromosomes instead of 46.

Individuals with an extra X or Y chromosome appear very tall but in most cases they look normal and do not show any physiological or medical abnormalities.

Men with the XYY syndrome were previously thought to be overly aggressive and more likely to become criminals. These original stereotypes came about because several researchers in the 1960s found a number of men with XYY syndrome in prisons and mental institutes. Since then, broader, less biased studies have been done on males with XYY and females with XXX syndrome.

Causes of Super male and Super female

This genetic disorder is caused by the presence of extra Y chromosome (XYY) or X chromosome (XXX). This causes changes in chromosomes from normal 46 to 47 chromosomes.

Effects of Super male and Super female

Normally the male with XYY chromosomes and the female with XXX chromosome or syndrome may be taller than average, they appear very tall in some cases. Also the people with XYY and XXX syndrome they have an increased risk for learning difficulties especially in reading and speech.

Klinefelter's syndrome (XXY)

This is a non-disjunction or genetic disorder resulting from failure of the XY or XX chromosomes of the gametes to separate and hence being inherited together. The victim has 47 chromosomes instead of 46. He is a male due to the presence of Y chromosome but he develops female secondary features.

Causes of Klinefelter's syndrome (XXY)

This genetic disorder is caused by failure of the XY or XX chromosomes of the gamete to separate, hence makes XY or XX chromosome to be inherited together. Hence results from 47 chromosomes instead of normal 46 chromosomes.

Effects of Klinefelter's syndrome

The individual with Klinefelter's syndrome usually has low intelligence: Male with Klinefelter's syndrome are typically tall and may have small testes and some breast development, although this is not necessarily obvious. They may also have difficult in learning and are usually infertile.

The genetic disorders may be caused by the chromosome mutation or gene mutation. Also the genes can be inherited together hence lead to genetic disorders. When genes that are inherited together they are said to be linked that is known as sex linkage. This sex linkage includes Haemophilia and Red-Green colour blindness.

Haemophilia

This is the hereditary disorder whereby blood clotting is delayed caused prolonged bleeding. People suffering from haemophilia may bleed for more than two hours following an injury. Bleeding may occur either in skin, muscles even in joints due to even a minor injury. Haemophilic girls are very rare; their chance to survive beyond puberty is minimum due to excessive bleeding during menstruation.

Causes of Haemophilia

It is caused by a recessive allele "h" carried on the X chromosome. It is easier for a haemophilic son to be produced from normal parents because a carrier female with single haemophilic allele on one of X chromosomes appears phenotypically normal. When she marries a normal man, there is a chance that they may get a haemophilic son.

Effects of Haemophilia

This causes the failure of blood clotting hence it leads to death. For the female an individual could not survive beyond the puberty age due to excessive bleeding during menstruation.

Colour Blindness (Red-Green Blindness)

This is a condition in which one fails to distinguish red from green colour. It is a sex linked hereditary disorder whereby an individual fail to distinguish red from green. As for Haemophilia, colour blindness is controlled by recessive gene, hence for the disorder to be expressed phenotypically it must be present in homogenous form in female, though for male a single allele is enough for the disorder to be expressed phenotypically.

Causes of Colour Blindness

This disorder as for haemophilia is caused by a recessive gene/trait carried by X chromosome. For example: If a heterozygous normal female (carrier) marries a normal male, the possibility of getting the colourblind son is expected.

Let,

X^cX^c - carrier female

X^cY - normal male

X^cY - colourblindness

Effects of Colour Blindness

This disorder is characterized by the difficulty in distinguishing Red from Green colour that may lead to accidents in traffic lights, when an individual will fail to determine Red light from Green light.

Application of Genetics

Application of Genetics in Everyday Life

Outline application of genetics in everyday life

Genetics affects us all in many ways. The uses of genetics are explained below:

Genetics can help us to understand why people look the way they do and why some people are more prone to certain diseases than others.

Genetics can help health-care professionals to identify certain conditions in babies before they are born using techniques such as prenatal testing.

Genetic technologies are also being used to help develop targeted medicinesfor certain diseases.

In addition to its use in health care, genetics has a range of other applications. For example, the police can use genetic fingerprinting to catch criminals.

Genetic fingerprinting was invented and developed by Sir Alec Jeffreys at the University of Leicester in 1984. This technique can identify individuals on the basis of their genetic information.

Criminals often leave evidence of their identity at a crime scene: for example, hair follicles, blood or skin cells. The police can use the genetic information to demonstrate whether or not an individual was present at the scene of a crime.

Genetic information can prove innocence and help to identify and convict the guilty.

The Importance of Genetics in Biological Science and Related Fields

Explain the importance of genetics in biological science and related fields

The various fields to which genetics discipline is applied include the following:

Determination of the blood groups genetically

Genetics is often applied to blood grouping. Blood grouping is very important in human life as it enables determination of blood groups so as the donor blood can be transfused to needy patients (recipients) without agglutination (clotting) or causing any adverse reaction. The four ABO blood groups are A, B, AB and O.

On the surface of the red blood cells are special proteins called antigens A and B. The A and B antigen molecules on the surface of red blood cells are made by two different enzymes. These two enzymes are encoded by different versions, or alleles, of the same gene.

The A allele codes for an enzyme that makes the A antigen, and the B allele codes for an enzyme that makes the B antigen. A third version of this gene, the O allele, codes for a protein that is not functional; it makes no surface molecules at all.

Everyone inherits two alleles of the gene, one from each parent. The combination of your two alleles determines your blood type.

The table below shows all of the possible combinations of blood type alleles. The blood type for each allele combination is shown on the right. For example, if you inherit a B allele from your father and an A allele from your mother, your blood type will be AB.

father \ mother	A	B	O
A	AA	AB	AO
B	BA	BB	BO
O	OA	OB	OO

alleles	blood type
A+A	A
A+O	A
A+B	AB
B+B	B
B+O	B
O+O	O

Possible combinations of blood type alleles

Blood plasma is packed with proteins called antibodies. The body produces a wide variety of antibodies that will recognize and attack foreign molecules that may enter the body from the outside world. A person's plasma does not contain any antibodies that will bind to molecules that are part of his or her own body.

When conducting a blood transfusion, it is important to carefully match the donor and recipient blood types. If the donor blood cells have surface molecules that are different from those of the recipient, antibodies in the recipient's blood recognize the donor blood as foreign. This triggers

an immune response resulting in blood clotting. If the donor blood cells have surface moleculesthat are the same as those of the recipient, the recipient's body will not see them as foreign and will not mount an immune response.

There are two special blood types when it comes to blood transfusions. People with type O blood are universal donors because there are no molecules on the surface of the red blood cells that can trigger an immune response. People with type AB blood are universal recipients because they do not have any antibodies that will recognize type A or B surface molecules.

Plant and animal breeding

The process of choosing animals and plants with certain desired qualities such as increased yields, tolerance to drought, resistance to disease and faster growth is referred to as artificial selection.

Artificial breeding is done by inbreeding or crossbreeding. Inbreeding involves breeding closely-related organisms. Thus the required qualities are retained from one generation to another.

Plants with desired qualities are inbred through successive selfing. Excessive inbreeding reduces genetic diversity, health and fitness.

Crossbreeding is also called hybridization. Different varieties of the same species are interbred in order to combine the advantageous traits of one variety with those of another.

Plants are crossbred to introduce traits/genes from one variety or line into a new genetic background. For example, a mildew-resistant pea may be crossed with a high-yielding but susceptible pea, the goal of the cross being to introduce mildew resistance without losing the high-yield characteristics. Progeny from the cross would then be crossed with the high-yielding parent to ensure that the progeny were most like the high-yielding parent, (backcrossing).

Traits that breeders have tried to incorporate into crop plants include:

Improved quality, such as increased nutrition, improved flavour, or greater beauty.

Increased yield of the crop

Increased tolerance of environmental pressures (salinity, extreme temperature, and drought)

Resistance to viruses, fungi and bacteria

Increased tolerance to insect pests

Increased tolerance of herbicides

Longer storage period for the harvested crop

Artificial insemination in the livestock industry has helped to produce a wide variety of cattle breeds which produce higher yields of milk or meat or both, sheep with high quality wool and poultry which produce good meat and eggs.

Genetic counseling

Genetic counseling is giving of professional advice and information about inherited disorders and diseases so as to help people make informed decisions.

The patients or relatives at risk of an inherited disorder are advised of the consequences and nature of the disorder, the probability of developing or inheriting it, and the options open to them to avoid propagating the problem to future generations.

The advice aims at controlling or preventing inheritable diseases and disorders like sickle-cell anaemia, albinism, haemophilia, colour blindness, etc.

In general, a genetic counselling session aims at:

increasing the family's understanding of a genetic condition;

discuss options regarding disease management and the risks and benefits of further testing and other options;

helping the individual and family identify the psychosocial tools required to cope with potential outcomes; and

reducing the family's anxiety.

People usually seek genetic counselling at the following times:

Before conception, when one or both parents are carriers or sufferers of a certain hereditary disorder.

During pregnancy, if an abnormality is detected in the embryo. Genetics can help health-care professionals to identify certain conditions in babies before they are born using techniques such as prenatal testing.

If a defect is noticed after birth.

If a genetic condition sets in during adulthood.

Genetic counsellors advice parents on how to minimize the risk of passing on certain traits to their children. For example, marriages between close relative increases the chances of alleles being homozygous. People with genetic disorders are also taught how to control them. Genetic counselling is also used to resolve controversies over parentage.

Genetic engineering

Genetic engineering is the process of manually adding new DNA to an organism. The goal is to add one or more new traits that are not already found in that organism. Examples of genetically engineered (transgenic) organisms currently on the market include plants with resistance to some insects, plants that can tolerate herbicides, and crops with modified oil content.

Genetic engineering has been applied to produce insulin cheaply using bacteria. This is done by transferring a gene that determines insulin production in a human cell into bacteria. Since bacteria reproduce very fast, large amounts of insulin can be produced within a short time. The insulin is then extracted from the bacteria and purified in readiness for use in the treatment of diabetes mellitus in human beings.

Genetic engineering is also used in the production of interferons. Genes responsible for interferon production are inserted into the DNA of yeast. Interferon is a chemical naturally produced by cells in order to inhibit viral growth during infection. It is used in the treatment of cancer and viral diseases.

Forensics (criminal investigation)

Forensics refers to use of science and technology to investigate and establish facts in criminal or civil courts of law. The police can use DNA fingerprinting to catch criminals. This technique can identify individuals on the basis of their genetic information. In practice, the test is used to determine whether a family relationship exists between two people, to identify organisms causing a disease, and to solve crimes. Only a small sample of cells is needed for DNA fingerprinting. A drop of blood or the root of a hair contains enough DNA for testing

Criminals often leave evidence of their identity at a crime scene: for example, hair follicles, blood or skin cells. The police can use the genetic information to demonstrate whether or not an individual was present at the scene of a crime. Genetic information can prove innocence and help to identify and convict the guilty.

Also in cases such as raping, DNA test of sperm remains retrieved from the victim's clothes or body may be used to establish evidence that could lead to conviction or release of the suspected rapist.

TOPIC 3 CLASSIFICATION OF LIVING THINGS

Kingdom Animalia

The word 'animal' is derived from the Latin word*animalis*which means 'having breath'. The Kingdom Animalia is characterized by eukaryotic and heterotrophic organisms. They are multicellular and lack cell wall. They depend directly or indirectly of plants for their food. Food is ingested and digested in their internal cavity and food reserves are stored as glycogen or fat. Nutrition is holozoic, i.e., by ingestion of food. Animals follow a definite growth pattern, the adults have a definite shape and size. Higher forms of animals exhibitwell developed sensory and neuromotor mechanism. Most of the organisms are capable of locomotion. Reproduction is by copulation of male and female which is followed bydevelopment in embryonic stages.

General and Distinctive Features of the Kingdom Animalia

Explain general and distinctive features of the kingdom animalia

Distinguishing characteristics of the Kingdom Animalia include:

Cell type - Eukaryotes

No cell wall

Nutrion - Heterotrophic, ingestion

Body form - Muticellular,(invertebrate/ vertebrate)

Nervous system - primitive to advanced sensory systems

Reproduction - All sexual, some also asexual

Locomotion - Ability to move at some point and time throughlife cycle

General characteristics of the Kingdom Animalia are as follows:

Animals are eukaryotic, multicellular and heterotrophic organisms.

They have multiple cells with mitochondria and they depend on other organisms for food.

Habitat - Most of the animals inhabit seas, fewer are seen in fresh water and even fewer on land.

There are around 9 to 10 million animal species that inhabit the earth. Only 800,000 species are identified.

Biologists recognize 36 phyla in the animals kingdom.

Size - The sizes of animals ranges from a few celled organism like the mesozoans to animals weighing many tons like the blue whale.

Animal bodies - Bodies of animals are made of cells organized into tissues which perform specific functions. in most animals tissue are organized into complex organs, which form organ systems.

Cell structure - The animal cell contains organelles like the nucleus, mitochondria, Golgi complex, ribosomes, endoplasmic reticulum, lysosomes, vacuoles, centrioles, cytoskeleton.

Animals are made up of many organ systems, that aids in performing specific functions that are necessary for the survival of the organism.

Organ systems are skeletal system, muscular system, digestive system, respiratory system, circulatory system, excretory system, reproductive system, immune system and the endocrine system.

Body symmetry - Most of the animals are bilaterally symmetrical, while primitive animals are asymmetrical and cnidarians and echinoderms are radially symmetrical.

Locomotion - Most animals have the ability to move, they show rapid movement when compared to plants and other organisms.

Respiration - It is a gaseous exchange of taking in oxygen and giving out carbon dioxide. This process takes place in organs of respiration like the lungs, gills, book gills and book lungs and some animals skin is also used for respiration.

Digestion - Animals ingest food, and digestion takes place in the internal cavity like the digestive system in animals, in primitive animals vacuoles are for digestion.

Nervous system - Sensory mechanism and the coordination of the organ systems is carried on by the nervous system. In animals the nervous system comprises of nerve ganglions, or brain, spinal cords and nerves.

Circulatory system - The distribution of nutrients, exchange of gases and removal of wastes takes place in the circulatory system. This system comprises of the heart, blood vessels and the blood.

Excretory system - Removal of wastes from kidneys.

Skeletal system - support and protection is provided by the skeletal system.

Reproductive system - Most animals reproduce sexually, by the fusion of haploid cells like the eggs and the sperms.

Glands of the endocrine system help in control and coordination of the body system.

The major Phyla of the Kingdom Animalia

Mention the major phyta of the kingdom animalia

Kingdom Animalia has approximately 36 sub-divisions known as 'phyla'. Each phyla share particular properties structurally and functionally which together separate it from other phyla. Below are the most common phyla classified under traditional biological methodology

Phylum Porifera- They are primitive organisms, most of them are salt-water sponges. They do not have organs or nerve cells or muscle cells. Approximately, 8,000 species exist today. Example:*Sycon, Euspongia, Spongilla.*Phylum Coelentrata (Cnidaria)- This group is composed of jelly-fish and other lower aquatic animals. Approximately, 15,000 species exist today.Example:*Aurelia, Adamsia*.

Phylum Platyhelminthes- This group consists of flat worms. They inhabit both marine and fresh water habitats and they are mostly endoparasites found in animals. Example:*Taenia, Fascicola*.

Phylum Aschelmeinthes- It is a group of round worms, most of them are parasites. This phylum consists of about 80,000 parasitic worms.

Phylum Annelida- They are present in aquatic, terrestrial and are free-living or parasitic in nature. This phylum comprises of segmented worms. Example: Earthworm, Leech etc.Phylum Arthropoda- This is the largest phylum which consists of insects. There are over 1 million species of insects existing today. Example: Locusts, Butterfly, Scorpion, Prawn.

Phylum Mollusca- It is the second largest phylum. They are terrestrial and aquatic. Example:*Pila, Octopus*.

Phylum Echinodermata- This consists of sea stars and sea urchins. There are about 6,000 species. Example:*Asteria,Ophiura*.

Phylum Chordata- Animals of this phylum have a characteristic feature of presence of notochord, a dorsal hollow nerve cord and paired pharyngeal gill slits. Within this phylum advanced group called vertebrates which include fish, amphibians, reptiles, birds and mammals.

Phylum Platyhelminthes

Etymology:-From the Greek*platy*for flat and*helminthes*for worms,Hence Flat Worms

The General and Distinctive Features of the Phylum Platyhelminthes

Explain the general and distinctive features of the phylum platyhelminthes

Characteristics of Platyhelminthes include:

Bilaterally symmetrical.

Body having 3 layers of tissues with organs and organelles.

Body contains no internal cavity.

Possesses a blind gut (i.e. it has a mouth but no anus)

Has Protonephridial excretory organs instead of an anus.

Has normally a nervous system of longitudinal fibres rather than a net.

Generally dorsoventrally flattened.

Reproduction mostly sexual as hermaphrodites.

Mostly they feed on animals and other smaller life forms.

Some species occur in all major habitats, including many as parasites of other animals.

The Structure of Organism under the Phylum Platyheminthes

Describe the structure of organisms under the phylum latyhelminthes

Platyhelminthes are mostly worm like creatures that are dorsoventrally flattened, meaning they look like a ribbon, this is why they are called names such as Tapeworm, Flatworm, Fluke and Planarian

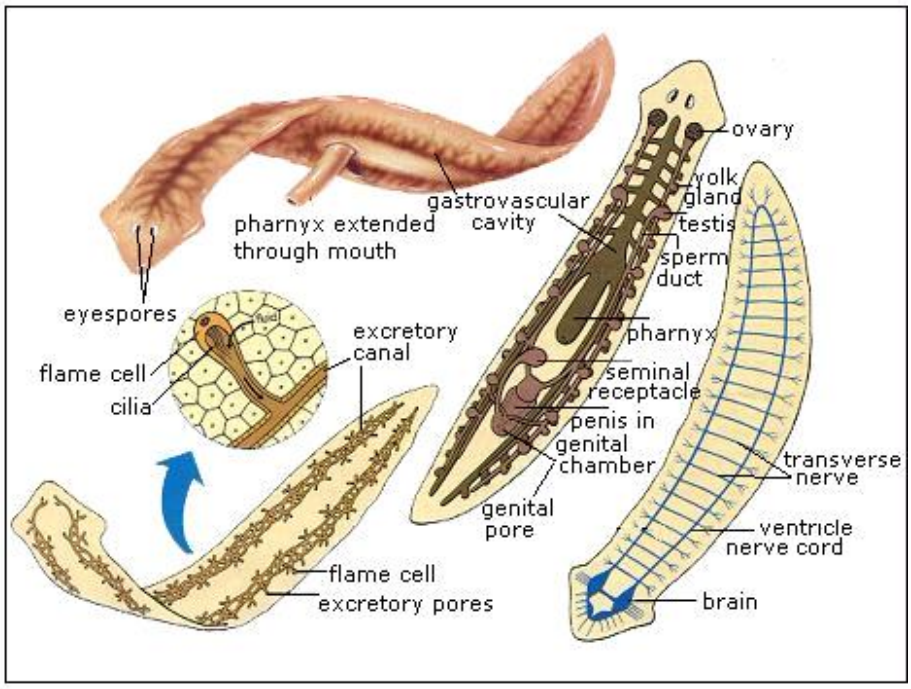
The Platyhelminthes are a successful phylum with around 25,000 known species divided into four classes. Most Platyhelminthes are parasites on other animals, only the Turbellarians are mostly non-parasitic. A few species are commensalists living in harmony, or mutual benefit with another, normally larger organism. Most species feed on animal material either as parasites or as scavengers, a very few species feed on algae. Although a few of the free living marine and terrestrial species are very beautiful, most species are not particularly attractive to the human mind.

Platyhelminthes live nearly everywhere, on land, in both fresh and marine waters as well as inside other animals. Most of the free living species are marine with only a small number inhabiting fresh water and very few being terrestrial. Parasitic species normally move between different habitats as they change life cycle stages and hosts. A number of parasitic species are of importance to mankind because they infect either our bodies or the bodies of our livestock. A few species can be fatal to humans if not treated, but nearly all species can be treated with modern medicines. Schistosomiasis (Bilharzia) is the most important platyhelminth disease of humans, causing much suffering and some death, over 200 million people are infected with the causative agent in tropical countries.

While they remain fairly morphologically simple the Platyhelminthes show several advance in body structure over the simple radial phyla that came before them. They have a definite

congregation of of sensory organs(a few have light sensing organs) and nervous tissues at one end of their body giving them a distinct head and tail. They also have distinct upper and lower (dorsal and ventral) body surfaces. They have a number of organs and even the beginnings of organ systems and a more distinct 3rd layer of cells in their body plan. The evolution of this connective tissue, called parenchyma, the cells of which serve as storage reservoirs as well as protecting the internal organs, is a major step forward toward the more complex body plans of higher animals, such as humans.

However they still no anus, instead they have only a blind ending gut, or no gut at all. Those species with a gut must therefore excrete there digestive waste products through their mouths.



Planarian Anatomy

Phylum Aschelminthes (Nematoda)

General and Distinctive Features of the Phylum Aschelminthes

Explain general and distinctive features of the phylum aschelminthes

Characteristics of Phylum Aschelminthes are:

Mostly parasitic (in animals and plants), a few free living called as flukes.

Body is long, cylindrical, fusiform (pointed at both the ends).

Body wall is composed of cuticle, epidermis and musculature.

Presence of a false body pseudocoelom not lined by epithelium.

Digestive system is complete.

Respiration by simple diffusion.

Nervous system consists of a nerve ring and many longitudinal nerve cords.

Only sexual reproduction. Sexes are separate with sexual dimorphism. Males are usually shorter than females

The Structure of Organisms under the Phylum Aschelminthes

Describe the structure of organisms under the phylum aschelminthes

The Phylum Nematoda (roundworms or nematodes) includes harmless, soil-dwelling roundworms (nematodes) that eat decaying organic material or small soil animals. The phylum also includes plant parasites that infect the roots of plants. These parasitic nematodes decrease the productivity of many human crops. The phylum includes several human parasites (see below).

Like the Phylum Platyhelminthes, the Phylum Nematoda consists of bilaterally symmetrical animals that have the organ system level of organization.

The Phylum Nematoda differs from the Phylum Platyhelminthes in two significant ways. First, roundworms have a complete digestive system. This means that there are two opening to the digestive system. The mouth at the anterior ingests or swallows food, and the anus at the posterior releases digestive waste. A complete digestive system is much more efficient than a cul-de-sac gut. The complete digestive system allows continuous processing of food. A roundworm can eat continuously, food digestion can occur continuously, and waste material can be released continuously. Animals with a cul-de-sac gut must wait until a meal has been digested, release digestive waste from the mouth, and only then swallow the next meal.

The second significant difference between the Phylum Nematoda and the Phylum Platyhelminthes is that the roundworms have a fluid filled body cavity. The presence of this structure allows space and cushioning for organs, provides the roundworm with a hydraulic skeleton, and aids in the distribution of food from the digestive tract to the other cells of the worm.

Several human parasites are roundworms. Many people in tropical countries are infected with hookworm. Immature stages of this parasitic worm burrow through the skin, travel through the blood vessels to the lungs, enter the air spaces of the lungs and crawl into the esophagus. The immature stage is then swallowed. The worm attaches to the intestine with hooks and matures into an adult. Fertilized eggs are released with feces, and the zygotes develop into immature

stages on soil. When people walk barefoot over the soil, they become infected. The mature hookworm drinks blood and lymph juices. They cause anemia due to blood loss.

The human roundworm is common where human feces is used as plant fertilizer. People ingest eggs when they eat plant material. The immature stages travel through the human body in blood vessels. Mature human roundworms live in the intestine where they produced eggs that are released with feces.

People can become accidentally infected with the trichina worm by eating undercooked port. The muscle of pork may contain immature stages of trichina worm. When people ingest the larval stage, it matures in the intestine where the adult worms reproduced. Immature stages migrate from the intestine to muscle tissue. There the larva forms a cyst. Since humans aren't generally eaten, the cysts become coated with calcium carbonate. This causes muscle stiffness. We call this condition trichinosis.

The Advantages and Disadvantages of Roundworms

Outline the advantages and disadvantages of roundworms

Roundworm parasitesaffect most species of animals and plants, making them important agricultural pests. There are also several species of roundworms that live in humans, some nasty, some not. Here are a few...

Trichinella spiralisis alsoa parasite that has been around for a while, since it has probably been responsible for several cultures long-standing dietary laws.*Trichinella*can be found around the world, more in temperate zones than the tropics, mostly in various animals that eat meat, from rats to bears. Humans most common exposure comes from pork, and pigs commonly pick it up from eating rats. These worms can live as juveniles in muscle and other tissues while adults occupy support tissues and the lymphatic system. A new host becomes infected by eating tissue containing juveniles. Juveniles become adults and mate in the new hosts intestines, then females bore out of the intestines, which can cause a wide range of serious symptoms, settle someplace and begin to release juveniles, which migrate all over the body, causing damage as they go, until they mostly coil up in muscle tissues and "wait" for the host to be eaten by a new host.

Hookwormsinfecta variety of mammals, with species in cows, dogs, cats, and others, as well as humans. Hookworms are fairly host-specific - worms of non-human hosts cant live long in a human. You definitely dont want to catch one of the hookworms specific to humans, though. They have a very unusual habit for worms that live in the intestine: instead of living on all of the food around them, they bite through the intestinal lining and live on blood. Serious infections occur when bacteria from the intestines get into the surrounding tissues and/or the blood, and heavy infections can produce enough blood loss to cause anemia. Its no wonder that one genus is called

Necator,or "killer"! Hookworm eggs pass in feces, and juveniles live for a while in the soil if its nice and wet. The worms get into the next host either by latching on and boring through their skin, or sticking to paws and getting licked off. If they come in through the skin, they get into the blood and migrate to the intestines, usually by way of the lungs, sometimes causing tissue damage as they go.Hookwormsfor non-human hosts that penetrate human skin by mistake can wander under the skin, unable to penetrate further, but the bodys reaction to them can cause a condition sometimes called***creeping eruption.***

Ascarisis animpressively largeworm, up to 50 centimeters long and about as thick as a pencil, that lives in human intestines, with maybe as much as a quarter of the worlds population infected. They aretaken inas accidentally-swallowed eggs, hatch in the intestine, and the juveniles bore out, get into the blood, wander the body (where they can cause problems), emerge in the lungs, grow there for a while (and possibly cause problems), then migrate up to be swallowed and get back to the intestines again, where they mate. Females find males by touch (its dark in an intestine) and crawl into the males hooked tail for mating; sometimes they mistake the opening of the ducts from the liver or pancreas for a males tail and get caught, blocking the flow of digestive juices. A heavy infection can produce aknot of wormsthat blocks movement of materials through the intestine. Females that cant find males have been known to migrate up or down the canal, reaching thenoseor anus in some cases - quite a surprise for the host! Females lay eggs that pass in feces. The eggs can remain infective in the environment for years, long after that fecal material has been broken down. Dirty hands in the mouth explains why children are the most common hosts for these worms.

Filarial wormsare a group of roundworms that commonly use biting insects to get juveniles from host to host, then the adults live in the fluid systems - blood or lymph systems - of the final host. There are several filarial worms that infect humans, including***Wuchereria,***which can block fluid drainage through the lymph system, causing grossswellingof tissues and a form of**elephantiasis.**

Onchocercacausesa disease called**river blindness**when juvenile worms enter and graduallydamagethe eyes (the "river" part is due to the biting fly carriers being tied to rivers for breeding, restricting thegeographical rangeof the disease).

Heartwormsarefilarial parasites of dogs and cats. The juvenile worms are carried by mosquitos, and the adults settle in the chambers and major vessels of the heart. Heartworms do not generally infect humans.

Dracunculus medinensis,alsocalled guinea worms, have been known and written about for centuries (although often called "serpents" in modern translations), including passages from Ancient Greek scholars and from the Bible. Adult worms can be as long as a meter, although they are very thin. As adults, they live in the tissues under the skin, usually somewhere at and below the hips, where they may be visible as a white line. After mating, a female produces huge numbers of eggs that hatch inside her and begin to migrate out into the surrounding tissue, often

causing an allergic reaction with inflammation and ulceration of the skin (some ancient texts call them the "fiery serpents" from their effects on the skin). When the skin breaks, many many tiny juvenile worms may emerge. An opening remains in the skin through which the female will continue to release young. To continue theirlife cycle, the juvenile worms must get into open water and infect a tiny crustacean; for this reason, worms are most active when the skin is wet.Ancienttreatments, still used in some places, involve cutting a thin slot in a stick, wetting the skin so the worm sticks out, catching the writhing worm in the sticks slot, then winding it slowly out from under the skin. The medical symbol, the***caduceus,***of asnakeorsnakeswrapped around a pole,most likelyis taken from one of the few effective devices ancient doctors had, a worm-removal stick (worm, snake; remember, in ancient classification schemes not much distinction was made among long wriggly things). Worms infect the next host whenwater containing infected crustaceans is drunk; the juveniles leave their carriers in the intestine, bore out of the intestine and migrate to their position under the skin. Humans are affected both by their allergic reactions to the released juveniles, infections from bacteria that enter through the broken skin, and worms that stall in deeper tissues, where they may cause serious damage. Because there is a fairly simple preventative measure - physically filtering drinking water -this parasite is very close to being eliminated.

Phylum Annelida

General and Distinctive Features of the Phylum Annelida

Explain general and distrinctive features of the phylum annelida

Characteristics of Annelida:

Bilaterally symmetrical and vermiform

Body has more than two cell layers, tissues and organs.

Body cavity is a true coelom, often divided by internal septa.

Body possesses a through gut with mouth and anus.

Body possesses 3 separate sections, a prosomium, a trunk and a pygidium.

Has a nervous system with an anterior nerve ring, ganglia and a ventral nerve chord.

Has a true closed circulatory system.

Has no true respiratory organs.

Reproduction normally sexual and gonochoristic or hermaphoditic.

Feed a wide range of material.

Live in most environments.

Structure of Organism under the Phylum Annelida (Earthworm)

Describe structure of organism under the phylum annelida (Earthworm)

The Annelida are a medium sized phylum of more than 9,000 species of worms. Most species prefer aquatic environments, but there are also a number of well know terrestrial species. Only a few species of annelids are commonly known to human beings, these include the delightful Rain, Dew or Earthworms that work so hard to make our soils healthy, the Ragworms and Lugworms used by marine fishermen and the much smaller Tubifex or Red worms used by aquarists to feed their fish. In many countries people are still familiar with Medicinal leeches, and people who live closer to nature are naturally more familiar with a much wider range of Annelids than those who live in cities.

Annelids range in size from the Giant Earthworms, of which*Michrochaetus rappi*(*Michrochaetus michrochaetus*) is the largest, this magnificent animal has an average length of 1.36 m (54 ins) and a record breaking specimen has been recorded that measured 6.7 metres (22 ft) in length, it was 2cm (0.8 ins) in diametre. Larger worms have been reported but not scientifically proven. The smallest Annelid known to science is*Chaetogaster annandalai*which is full grown at 0.5 mm (0.02 ins).

Annelids have two main modes of existence, they either live rather quietly in holes or they live more active lives. The basic Annelid body plan is one of a head followed by a long thin body of numerous similar segments ending in a small tail. The head consists of a mouth (prostomium) and sometimes a peristomium, and the tail is more correctly called a pygidium, as it is not really a tail. Annelids are coelomate animals meaning they have a true coelom within their body. They have sets chaetae attached to each body segment, and these can be simple and small as in the Earthworms or complex and varied as in many Polychaetes. The head is often reduced and difficult to distinguish in the hole living species, but may be easily recognised, with eyes and other sensory devices in those species living a more active life.

Annelids are coelomate animals (meaning they have a truecoelom, even if this is reduced secondarily). They normally have long thin bodies composed of a series of identical segments. These segments lie between the head, comprised of a prostomium, a mouth and sometimes a peristomium, and a tail called a pygidium. Growth occurs both laterally, by enlargement of the segments during the juvenile stages, and through the addition of new segments. New segments are produced by the foremost section of the pygidium. In some species they are produced throughout the animals life but in many species production stops once a certain set number of segments has been achieved.

Advantages and Disadvantages of Lumbricus (Earthworm)

Explain advantages and disadvantages of lumbricus (Earthworm)

Despite the amazing and delicate beauty of polychaetes such as the Fan Worms, and the huge (really beyond estimation) economic debt owed by mankind to the Oligochaete Earthworms for their work in soil creation and maintenance many people still fail to appreciate their true wonder and beauty.

The earthworms, of which there are many species, are exceedingly important in soil creation, particularly in temperate areas. Without them, agriculture and perhaps the whole of human society as we know it would never have evolved. Like so much of the unnoticed invertebrate world earthworms are essential to our very existence. In marine environments the numerous species of Polychaetes play a fundamentally important role in the maintenance of food chains and the whole ecological balance of the seas, thus supporting the seemingly endless stocks of fish we like to eat.

One of the strangest ways that humans relate to Annelids is in the hobby of 'Worm Charming'. This involves enticing earthworms from their holes (catching them), originally it was a means of acquiring worms for bait, but now-a-days it is a sport. The world record as far as I know is held by Tom Shufflebotham who charmed 511 worms from their underground hideouts from an area of 3 square metres in only 30 minutes during the 1980 Annual Worm Charming Championships held in Cheshire UK. The rules specify that the worms must be brought to the surface without using refreshment, stimulation, drugs or digging. Tom used a method called twanging which involves sticking a 4-pronged pitchfork into the ground and twanging it.

Phylum Arthropoda

General and Distinctive Features of the Phylum Arthropoda

Explain general and distinctive features of the phylum arthropoda

Phylum Anthropoda has more species than any other phylum. An arthropod’s body plan is segmented just as annelids. They have appendages, which serve a variety of purposes such as gaseous exchange, food gathering, locomotion and direction of stimuli.Arthropods have an exoskeleton or cubicle that is secreted by the epidermis. Their skeleton is made up of chitin.

Their exoskeleton serves different purposes such as:

Support

Attachment for muscles; and

Protection from physical damage

They have jointed appendages used for various functions such as feeding, locomotion and sensory purposes.

Arthropoda have developed distinct regions of the body, namely the head, thorax and abdomen. The head possesses sensory receptors such as eyes and antennae as well as feeding appendages. The head is more developed in annelids with a larger brain. Some classes of the phylum e.g. insects have developed flight which greatly increases opportunities for finding food and escaping from predators.

Distinctive Features of the Phylum Arthropoda

They have an exoskeleton made up of a chitin and sometimes-calcareous matter, which may either, be rigid, stiff or flexible.

Each segment in arthropoda typically bears a pair of jointed appendages used for locomotion or feeding or sensory purposes.

Classes of the Phylum Arthropoda

Mention classes of the phylum arthropoda

Classes of the Phylum Arthropoda include:

Class: Crustacean

Class: Insecta

Class: Chilopoda

Class: Diplopoda

Class: Arachnida

Examples of Organisms under each Class of the Phylum Artropoda

Cite examples of organisms under each class of the phylum artropoda

Examples of Organisms under each Class of the Phylum Artropoda include:

Class Crustacean: Crustacea is a class of organisms whose bodies are covered by a hard shell called carapace.Examples of crustaceans are woodlice, water flea, Cray fish, crabs, lobsters, shrimps and barnacles.

Class Insecta: Insects are the most successful organisms on earth since they possess an exoskeleton, which reduces water loss from the body. Insects are the largest group of arthropods. They occupy every habitat an earth in such places as air, soil and water. However they mainly inhabit terrestrial habitats. Examples of insects include grasshoppers, houseflies, butterflies, bees and termites.

Class Chilopoda: Class Chilopoda is made up of centipedes. The centipede is mainly found on land

Class Diplopoda: Class Diplopoda is made up of millipedes. Millipedes are common in damp places.

Class Arachnida: Arachnida are terrestrial arthropods. Examples of arachnids are spiders, ticks, scorpions and mites.

Distinctive Features of each Class of the Phylum Arthropoda

Explain distinctive features of each class of the phylum arthropoda

Distinctive features of ClassCrutacean

Crustacea are mainly found in marine and fresh water thus they occupy aquatic habitats

Their gaseous exchange is by means of gills or through the body membrane

Their bodies are divided into two main parts: the head and thorax are fused to form a Cephalothorax the second part is the abdomen

They have a pair of compound eyes each on a raised stalk

They have two antennae

They have four pairs of mouthparts namely maxilla, mandible, labium and labrum

They have five pairs of limbs that are modified for swimming

Distinctive features of Class Insecta

Insets have three body parts namely the head, thorax and abdomen

They have one pair of antennae

They have a pair of compound eyes. In some cases simple eyes are also present

They have three pairs of walking legs per segment of the thorax

Most insects have one or two pairs of wings on the second or third segment o the thorax. Some insects have no wings

They breath by means of air holes called spiracles and carry out gaseous exchange through the tracheoles of the tracheal system

They undergo complete or incomplete metamorphosis with a larva stage

They mainly occupy terrestrial habitats

Distinctive features of Class Chilopoda

Centipedes have a clearly defined head while the rest of the segments are similar

They have a pair of antennae

They have one pair of mouthparts known as mandibles

They have simple and compound eyes, although some lack compound eyes

They have a pair of legs in each body segment

They carry out gaseous exchange by means of tracheoles of the tracheal system

They feed on insects and worms

They occupy terrestrial habitats

They have one pair of poison claws

Distinctive features of Class Diplopoda

Millipedes have a clearly defined head. All the other body segments are basically similar

They have one pair of antennae

They have one pair of mouthparts namely, the mandibles

They have simple and compound eyes, although some lack compound eyes

They have two pairs of legs in each body segment

They carry out gaseous exchange through tracheoles of the trachea system

They feed on plants

They inhabit terrestrial habitats

They have a cylindrical body

Distinctive features of Class Arachnida

Arachnids have two body parts. The head and thorax are fused to form cephalothorax or prosoma, the abdomen is referred to as opithosoma.

They do not have mouthparts. However they have one pair of appendages for sensing prey and another pair for capturing the prey

This pair of appendages is known as chelicerae. Thus they have a carnivorous mode of feeding

They have simple eyes

They have four pairs of walking legs

They carry out gaseous exchange by the lung book or trachea

A lung book consists of folds of ectoderm with slit like opening on the surface of the abdomen

Arachnids do not have wings

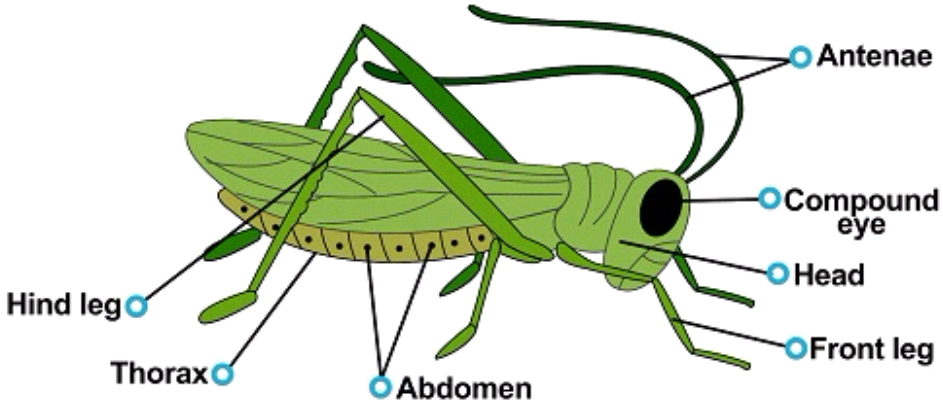
They inhabit terrestrial habitats

Structures of Representative Organisms under each Class of Phylum Arthropoda

Describe structures of representative organisms under each class

Structures of Representative Organisms

GRASSHOPPER



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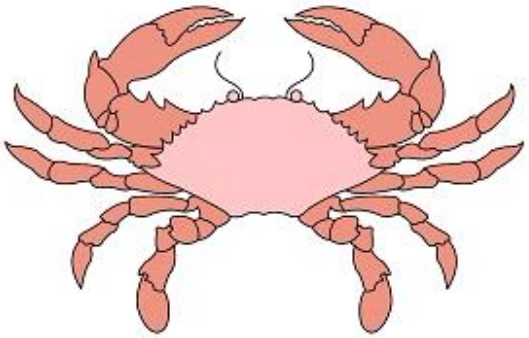

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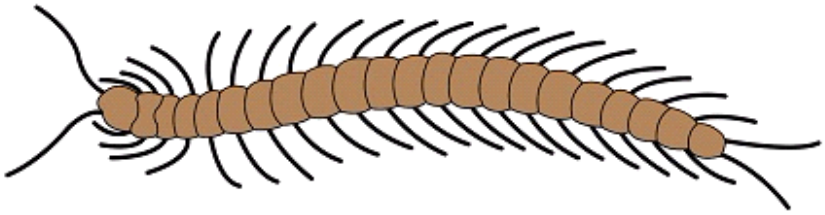


The Advantages and Disadvantages of the Organisms under each Class of Phylum Arthropoda

Explain the advantages and disadvantages of the organisms under each class of phylum *arthropoda*

IMPORTANCE OF CRUSTACEANS

Human beings use crustaceans as food especially lobsters, shrimps, crabs and crayfish

Some of them are used for decorations in the homes especially crabs and crayfish

Most crustaceans attract tourists during their visits especially along the beaches

IMPORTANCE OF THE CLASS DIPLOPODA

The millipedes can be useful like earthworms; they help to aerate the soil

IMPORTANCE OF INSECTS

Most insects are naturally useful in pollination e.g. bees and flies

Other insects e.g. bees are able to make various substances like honey and wax that are consumed by humans and wax is used for making candles

Some insects like termites and earthworms help to turn the soil over and so keep it lose and aerated

Most insects are vectors of several species of disease causing organisms e.g. mosquito is the vector for plasmodium that causes malaria in humans. Flies are vectors for filarial worms that cause river blindness in humans

DISADVANTAGES OF INSECTS

Many insects transmit diseases to people by transmitting contaminated material by means of their appendages e.g. houseflies transmit cholera by carrying contaminated stool to whatever can be consumed by human beings.

IMPORTANCE OF ARTHROPODA

They cause damage to crops and forestry, locusts and some larvae e.g. feed on crops

They spread diseases to humans and other domestic animals e.g. female anopheles spreads malaria, while tsetse flies spread sleeping sickness

They are source of food e.g. green grasshoppers, termites, crabs and shrimps

They cause damage to household materials e.g. cockroaches damage furniture

Some members aid pollination e.g. bees, butterflies and lady birds

Phylum Chordata

Phylum chordata is found in the kingom Animalia. Members found on phylum chordata are fish, frog, lizard, birds, rats etc.

General and Distinctive Characteristics Features of the Phylum Chordata

Explain general and distinctive characteristics features of the phylum chordata

General Distinctive Characteristics of Phylum Chordata are:

They have a notochord in the embryonic stage. If they notochord persists throughout the life span, it may be surrounded by a vertebral column as in lungfish or it may both be surrounded by a vertebral column as in some chordata

Their nerve cord is hollow and placed dorsally to the gut

They have gill slits at least during the embryonic stage

They have tail which is behind the anus

Classes of the Phylum Chordate

Mention classes of the phylum chordate

The phylum chordata consists of six classes which are

Class Chondrichthyes

Class Osteichthyes

Class Amphibia

Class Reptilia

Class Aves and

Class Mammalia

Distinctive Features of Each Class of the Phylum Chordata

Explain distinctive features of each class of the phylum chordata

Distinctive features of Class Chondrichthyes

The skeleton is made up of cartilage

The body is covered with placoid scales

The caudal fin has tow lobes that differ in size

Each pair of gills is in a separate compartment

The mouth and two nostrils are ventrally placed

Males have Copulatory structures called claspers

Distinctive Features of Class Osteichthyes

The skeleton is made up of bones

The body is covered with ganoid scales

The mouth is terminally placed and nostrils are forced on the dorsal surface

All pairs of gills are found in common chamber and the chambers are covered by an operculum

The caudal fin has loves of the same size

Distinctive Features of Class Amphibia

Their skin is always moist example frogs

Their life cycle involves larva form called tadpole

They have gills which are present in the early stages of the development of the tadpole

They have a heart which has three chambers

There is gaseous exchange by gills in the tadpole and in the adult it takes place in the lungs, skin and the mouth lining

Distinctive features of Birds

The body is covered with feathers

The anterior pair of limbs is modified into wings

The mouth is modified into a beak or bill

Distinctive features of Class Mammalia

Their body is covered with hairs

They have mammary glands

They have teeth of different types and shapes

They have diaphragm

Their red blood cells have no nucleus

They have sweat glands. The body temperature of mammals is constant

Structure of Representative Organisms in each Class of Phylum Chordata

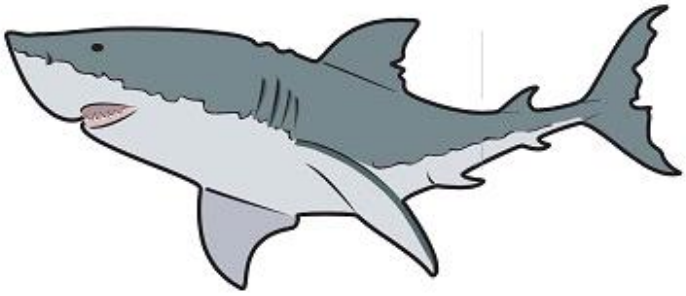
Describe structure of representative organisms in each class of phylum chordata

Structure of Amphibians

The body of toad or frog consists of a head and trunk only. The skin is dry and warty in toads and smooth and shiny in frogs. On the head are pair of nostrils and lower eyelids, which are almost immovable.

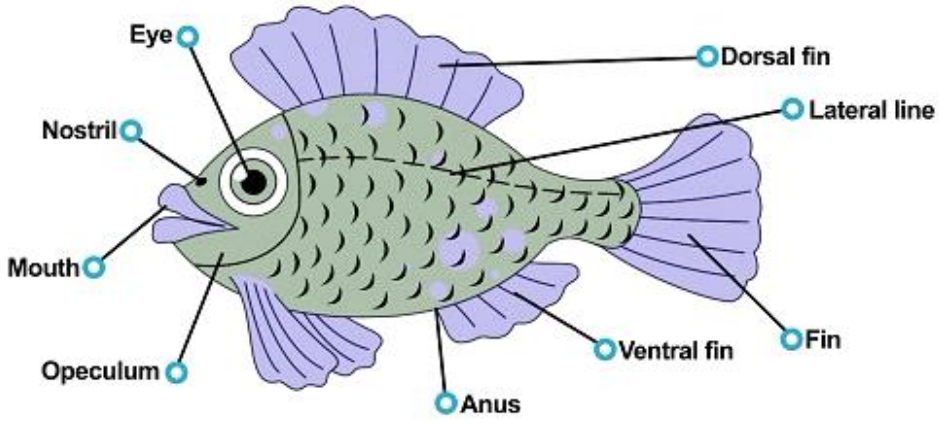
The fore limbs of toads and frogs are short. They have 4 digits on each hand, as the thumb is missing. The hind limbs are much longer than the front ones and the feet are very large. A thin web of skin, which is particularly well developed in frogs, joins the toes. Adult toads are mainly land animals and usually enter water only to breed.

SHARK



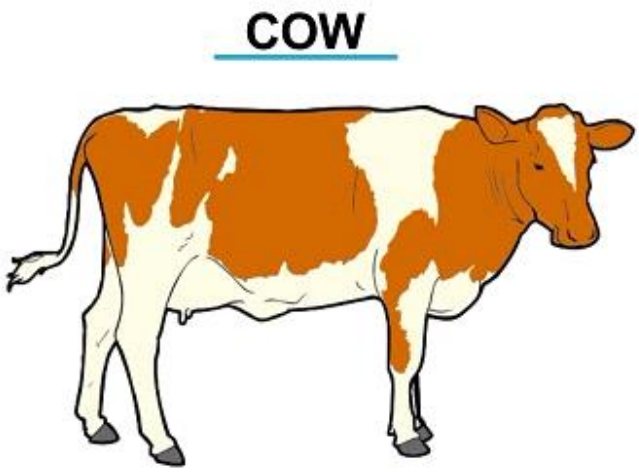
Example of Specimen found on Class Chondrichthyes

TILAPIA



Example of Specimen found on Class Chondrichthyes

Example of Specimen found on Class Aves



Example of Specimen found on Class Mammalia

Example of Specimen found on Class Reptilia

The advantages and disadvantages of Organisms under each Class of Phylum Chordata

Outline the advantages and disadvantages of organisms under each class of phylum chordata

Importance of Amphibians

They are ecologically important

They are used in research specimen

Some amphibians are eaten as food

Some amphibians have unique features. Example abnormally big sizes attract tourists

They have typical characteristics of larger animals hence they are among the most preferred specimens for biological studies

Importance of Class Reptilia

Reptiles act as attractive features e.g. colour of snake

Reptiles are used as a source of food for other species example birds feed on snakes

Reptiles are used in decorations in houses

Disadvantages of Class Reptilia

Can cause death to human beings, for example a snake

Importance of Birds

Flesh of several species is used as food for human beings example chicken, duck

The feathers of birds are used for decorations

Birds are also used for the pollination of seeds and fruit dispersal

Some birds like Ostriches are attractive to tourists

Some species of birds are used for biological control

Importance of Mammals

Most mammals serve as source of food for human beings example cows, sheeps

Mammals help in production of manure example manure from cows, goats

The bones of mammals are used for production of animal charcoal

Most wild animals in national parks and game reserves attract tourists

Some domestic mammals such as cows and donkeys are trained to perform human duties such as cultivation of crops

EVOLUTION

The universe is a system made up of the stars, planets and the space surrounding them. The earth is the one of the planets in the universe. Plants, animals and other organisms like man, inhabit the earth. For many centuries man has witnessed and appreciated changes, which occur in nature and within his immediate surroundings. For example many thousands of years ago the Sahara desert was not there, instead the entire area was covered with a thick forest. Due to changes in weather the forest gradually disappeared and gave way to present desert. All this gives us the concept about organic evolution.

Concept of Organic Evolution

The Concept of Organic Evolution

Explain the concept of organic evolution

Evolution is the gradual development of organisms from simple form to more complex forms over a long duration of time. Evolution is marked by emergence of new species from pre-existing species and the disappearance of some species. The species that disappear are said to become extinct.

Key terms used in organic evolution

Carbon dating: This is a method of estimating the ages of dead materials of biological origin.

Natural Selection: This is selective force occurring in nature, which is responsible for eliminating the unfavourable traits to retain only favourable traits in the population.

Specie: These are organisms, which have ability to interbreed freely to produce fertile off springs.

Fossils: These are the remains of organisms that lived in the past, preserved naturally in rocks, peat or ice.

Importance of Studying Evolution

It helps to understand the biological forces that cause organisms to develop from simple to more complex organisms to the extent of new species emerging

It helps to know how different organisms relate

Theories of the Origin of Life

The basic ideas about the origin of life

Outline the basic ideas about the origin of life

The theories of the Origin of Life

State the theories of the origin of life

There are numerous theories of evolution that try to explain the origin of living things. The main theories of the origin of life are:

- Theory of Special Creation
- Theory of Biochemical Evolution
- Theory of Spontaneous Generation
- Steady State Theory
- Cosmozoan theory

The Theory of Special Creation

According to this theory life was non-existent before a particular time. Then the Supreme Being (Supernatural power) created all living things and there was life on Earth from then henceforth.

This theory proposes that differences and similarities between organisms are as a result of how the organisms were created. Major religions like Christianity, Islam and Buddhism have theories that support special creation. The theory of fixed status and catastrophism was put forth by Cuvier to support the religious point of view. According to Curvier, fossils were brought about by catastrophes such as floods as outlined in the holy bible. During the floods the earth's surface was deformed and many creatures were killed and covered by a mass of land.

The Theory of biohemical Evolution

According to this theory, about 13.7 billion years ago, a cosmic explosion occurred and the universe has since been expanding and cooling. Before the explosion, the earth was very compact, dense and hot.

The formation of the universe created condition like high ultraviolet radiation and high temperatures. The gaseous composition was different from todays. The universe cooled and protons combined with electrons to form hydrogen atoms, which were the first atoms to be formed.

Hydrogen combined chemically with other elements to form compounds such as water, hydrogen is present in almost all organic compounds.

This theory was advanced by Alexander Oparin in 1923, he stated that in the beginning the atmosphere contained ammonia, carbon dioxide, helium, hydrogen and methane but lacked oxygen. The compound was a result of high temperature, ultraviolet radiation and electrical discharge that were plentiful after cosmic explosion.

The compounds were dissolving in rainwater to form nutrient both (a mixture of organic compound in water that accumulated in the water bodies on the earth's surface). The simple compounds combined to form complex substances, using energy from the high temperature and ultraviolet rays later polymers such as proteins lipids and carbohydrates were formed. The first single-celled organism arose from these polymers.

The formation of ribonucleic acid (RNA) a self-replicating molecule was a pre-requisite to life as the form could replicate itself. Living organisms could reproduce themselves. The first life forms were heterotrophic using the compound in the nutrient broth as food. The organisms reproduced by budding

The Theory of Spontaneous Generation

Aristotle advanced the theory of spontaneous generation and it dates back to the 4^{th} Century. The theory was applied up to the 19^{th} Century but it is no longer applied. The scientists believed that simple organisms like worms and frogs could arise from mud, dust or rotten food. **That means life can originate from non-living matter e.g. maggots can arise from rotten meat.**

The Steady State Theory

This theory was popular during the 1950s and 1960s, before its demise in the late 1960s. According to these theory the universe has always existed and has no origin that is it did not have a moment of creation this life has no origin

Cosmozoan Theory

Also this theory states that or suggests that life on earth originated from elsewhere. In eighteenth century scientists questioned these steady state and Cosmozoan theories due to the presence of fossils and emergence of new species.

Theories of Organic Evolution , Lamarckism

Lamarck's theory of Evolution

State lamarck's theory of evolution

Darwin was not the only person to develop a theory of evolution. Jean-Baptiste Lamarck was a French scientist who developed an alternative theory at the beginning of the 19th century. His theory centred on two ideas:

the law of use and disuse

the law of inheritance of acquired characteristics

His theory stipulated that a characteristic which is used more and more by an organism becomes bigger and stronger. One that is not used disappears eventually. Any characteristic of an organism that is improved through use is passed to its offspring.

Lamarck's Observations and Deductions

Explain lamarck's observations and deductions

Jean Baptiste Lamarck was a French naturalist. Lamarck formulated a theory on evolution after studying botany and the fossils of marine invertebrates.**His theory was based on the use and disuse of body parts and inheritance of acquired characteristics the offspring then adapt further, advancing evolution of the species**

He used the law of use and disuse which explains that organism enhanced certain abilities by exercising them and lost other abilities through disuse example the ancestors of the present day long necked giraffe. These early giraffes fed on short plants when the short plants became scarce the giraffe had to stretch their necks to feed on taller plants. Thus their necks became longer. The longer necks were passed onto their offspring hence after a long time giraffe developed the long necks they have today.

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Merits and Demerits of Lamarck's Theory of Evolution

Outline merits and demerits of lamarck's theory of evolution

The Merits of Lamarck's Theory of Evolution include:

- Lamarck theory lead to further studies on evolution of species

- It gave rise to discovery of genes and genetics which is now widely used in many fields of biology
- He tried to explain the role of environment on evolution of organisms
- Upon rejection of his theory Lamarck decided to study about invertebrates which made great contribution in development of Zoology

shortcomings of lamark theory

- the use or disuse can not determine existance or disapearence of body structure
- he had no knowledge of genetics

Darwinism

Darwin's Theory of Evolution

State Darwin's theory of evolution

Charles Robert Darwin (1809 – 1882) was an English naturalist. He based his theory on observation made during a five-year geographical study.

Darwin's main observations were:

- Every generation of organisms have more off springs than parents. However, the number of adult organisms remains generally stable from generation to generation. Therefore is a struggle for existence that causes many off spring to die before becoming adults
- There are many variations in a species. Variations are passed from parents to their off spring. Advantageous variations enable survival in the environment organism with disadvantageous variation due. This is called survival of the fittest.
- Off springs with favourable variations grow into adults and reproduce therefore favourable variations accumulated in the species; enabling adaptation to the environment, this gives rise to new specie.
- A change in the environmental conditions favours other characteristics of the organisms. The effect of these changes on the organisms is that other features become more prominent than before resulting in evolution.

Merits of Darwin's theory

- The theory enabled scientists to carry further studies, leading to new discoveries that suggest the origin of life

- Helped scientists to understand about drug resistance and evolution of germs like bacteria and viruses leading to new strains
- Enable further research to find cure or vaccines of germs, bacteria and viruses

Shortcoming of Darwin's Theory:

- He failed to explain how variations in populations arose and were maintained from one generation to the next.
- He had no knowledge of genetics

Evidences and application of Organic Evolution in the Real Life Situation

Investigate evidences and application of organic evolution in the real life situation

Scientists can prove that evolution has taken place by various methods. Some of these methods are

- **Comparative anatomy:**Comparative anatomy is the study of biological structures in different organisms. **Homologous structure**-The scientists look at structures that are similar in different organisms or species. Example limbs of vertebrates such as human beings, goats and wings of birds are used for different purposes but they have a basic design structure, this is known **as homologous** structure.Example fore limbs of humans are for manipulation, fore limbs of birds (wings) are for flight and fore limbs of a goat are for walking; this shows that all these animals are from common ancestors**. Analogous** structures are the ones, which look different, but they perform similar functions e.g. insect, birds and bats all have wings used for flight but they have different structural organization. **Vestigial structure**- structures that have lost function on a course of time but have functions in other organism.example coccyx, human appendix, wings of flightless ostrich
- **Fossil records:**Fossils are remains of organisms that lived in the past preserved naturally in rocks or on ice. The study of fossils is known as paleontology when fossils are dated scientists can estimate the age of that organism. Method used by scientists to know the age of fossils is carbon dating using isotope of Carbon 14.
- **Embryology:**In comparative embryology embryos of different vertebrates at early stages are compared and they are seen to have resemblances. Species that show similar embryonic development are assumed to be closely related although the adult may be quite different
- **Natural Selection in Action**:Nature led to the selection of a genetic combination that resulted in a more frequent melanic variety compared to the non-melanic variety. Before the industrial revolution in Europe the white variety of moth was more prevalent.

Industrialization in Europe in the 18th Century polluted the environment, burning of coal released a lot of soot and smoke. These pollutants coated tree trunks, killing the lichens that grew on the tree trunks. The colour of the tree trunks became black; this camouflaged the dark melanin form of the peppered moth. The predators of the moth did not feed on many dark moths because they were not very visible.

- **Evidence from vestigial organs:** These are structures, which have been greatly reduced and ceased to be functional. Presence of vestigial organs is an indication that they existed in ancestral forms but as a result of evolution such structures have been so much reduced to the extent of loosing or greatly changing their original function. Examples of vestigial structures are wings of flightless birds such as ostriches and penguins.
- evidence from classification
- geographical distribution
- comperative biochemistry

QN. write short notes on each of the following

i. convergent evolution
ii. divergent evolution.
iii. adaptive radiation
iv. natural selection

TOPIC 5 HUMAN IMMUNO DEFICIENCY (HIV) ACQUIRED IMMUNE DEFICIENCY SYNDROME (AIDS) AND SEXUALLY TRANSMITTED INFECTIONS (STIS)

Relationship Between HIV, AIDS and STIs
Defference between HIV, AIDS and STIs

Distinguish between HIV, AIDS and STIs

HIV/AIDS (Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome)

Acquired means “to get from” this means that AIDS is gotten from other people, “Immune” means “protect”, this means that the body is normally protected against many diseases. Deficiency means “lack: and syndrome means a group of different symptoms of diseases.

AIDS is the pandemic disease, which is caused by a certain type of organism called virus. These types of viruses are called Human Immunodeficiency Virus.

The Human Immunodeficiency Virus destroys the Immune system, destruction of the immune system makes it easy for the body to be attacked by other diseases.

It takes a long time for HIV to damage the immune system. It takes years before the body's immune system is destroyed. That is why some people may have HIV in their bodies but not look or feel sick yet. We call these people HIV carriers because they carry the virus in their bodies. When HIV carriers finally begin to show the sign and symptoms of AIDS then we say they have AIDS.

STDS and STIs (Sexually Transmitted Diseases and Sexually Transmitted Infections)

STDs and STIs are diseases and infections, which are transmitted through sexual intercourse. Examples of diseases and infections are: gonorrhea, syphilis, trichomoniasis, candidiasis, chlamadia, genital herpes and hepatitis B.

The Relationship between HIV and STIs

Explain the relationship between HIV and STIs

The link between HIV and other STIs might seem obvious. After all, the same sorts of risk behaviour are involved. However, numerous studies seem to indicate that there is a stronger association between HIV and other STIs than would be expected simply from a behavioural link. Infection with STIs (including syphilis, gonorrhoea and herpes) seems to increase the risk of both acquiring and transmitting HIV over and above a behavioural link. So does bacterial vaginosis, a condition not formally classed as an STI, since it appears not to be transmitted, but which is associated with poor sexual health generally.

Depending on the STI involved and the population, studies have reported that having an STI magnifies the risk of acquiring HIV by anything from two to eight times or more. In the case of people with HIV, having an STI increases viral loads both in the blood and genital secretions, thus making people more infectious – even when taking antiretroviral treatment.

Transmission of HIV/AIDS

HIV can be transmitted by:

Sexual intercourse with infected person

Blood Transfusion from an infected person

Organ transplant from an infected donor

An infected mother to her child during pregnancy, birth or breastfeeding

Using unsterilized surgical instrument e.g. scalpel, needles etc

Sharing toothbrushes, sharing blades, nail cutter with infected person

Symptoms and Signs of HIV/AIDS

The following are symptoms of HIV/AIDS

Loss of weight

Persistent fever that lasts longer than a month

Diarrhea

Coughing for more that a month

Itchy rashes on the skin

White layer in the mouth and throat

Swollen gland especially in the neck and armpit

Genital rashes

Shortened breath

Effects of HIV/AIDS

People with AIDS get opportunistic infections and diseases, example of these infections and diseases are:

Chest infection such as pneumonia and Tuberculosis (TB)

Brain infection leading to mental confusion

Sever headaches and fits (seizures)

Stomach infection leading to diarrhea lasts for weeks

Skin cancer known as carposis sarcoma

Management and Control of HIV/AIDS and STIs

Ways of managing and controlling HIV, AIDS and STIs

Outline ways of managing and controlling HIV, AIDS and STIs

Prevention and Control Measures include:

Avoid irresponsible sexual behavior. Follow ABC guide: **A**bstain from sexual intercourse. This is the best method of prevention for the unmarried people **B**e faithful to one sexual partner
Use **C**ondom during sexual intercourse

Use sterilized instruments during surgery, circumcision and delivery

Wear disposable gloves when you touch other people's bodily fluids

Only screened blood and organs should be used for transfusion and transplants

Go for HIV and AIDS test in order to know your status

Do not share toothbrushes and blades

People with HIV and AIDS should be given anti retroviral drugs (ARVs) which help to slow down the progression of the diseases in the body

Pregnant women should attend pre-natal clinic where they can be treated to prevent mother to child transmission

HIV positive mothers should not breastfeed their newborn babies

The Life Skills Needed for Home based Care for PLWHA

Mention the life skills needed for home based care for PLWHA

People with HIV and AIDS can live healthy lives for a longtime if they get proper care and support. We can care for them and support them in the following ways:

Giving them well-balanced meals in adequate quantities

Allowing them to rest when they feel unwell

Taking them to a health center as soon as they start developing signs of illness

Providing them with ARVs which help to slow down the advancement of the condition

Allowing them to work and exercise if the can

Behaving in a loving way toward them

Listening to them and helping them when they have a problem

Counseling them to stop behaviors that could worsen their condition. Example: taking drugs or having many sexual partners

Not discriminating against them or stigmatizing them by doing the following: Branding them names such as “walking corpse”; Denying them education or health services; Denying them work opportunity; Chasing them away from home; Refusing to share utensils or room with them; Not involving them in decision-making processes; Hiding them from the public.

Keeping their bodies, clothing and bedding clean

Precautions to be taken when Handling People Living with HIV/AIDS (PLWHA) and STIs

Mention precautions to be taken when handling people living with HIV/AIDS (PLWHA) and STIs

Carers will have their own concerns and worries, fears for the future, for their families and for their own health. It is important that they take care of themselves, get enough rest and have the

appropriate information and support to carry out their difficult task. The important messages given below cannot be emphasized enough.

HIV/AIDS is not spread by food or water.

HIV/AIDS cannot be spread by sharing food, dishes or cooking utensils such as cups, plates, knives and forks with a person who is HIV positive.

HIV/AIDS cannot be spread by touching another person, hugging, shaking hands or holding other people in a normal way. There is no need to avoid body contact with a person living with HIV/AIDS.

Counseling and Voluntary Testing (CVT)

The concept of Counselling and Voluntary Testing

Explain the concept of counselling and voluntary testing

Counselling and voluntary test is the process that is undertaken when a person wants to find out if she/he is affected with HIV. Because it is voluntary, a person who think they might have HIV decide on their own whether they want to have the test done or not. If the individual decided to go ahead with testing they will have the opportunity to discuss the test with a trained counselor. Most clinics use rapid accurate scientific tests that make the result available, usually within twenty minutes after the test has been performed.

Voluntary counseling and testing (VCT) for HIV is an efficient internationally recognized approach for people to find out their HIV status at a VCT center. VCT has become one of the most effective and popular ways of diagnosing people who may have been exposed to the virus or who have been infected.

The Significance of CVT in the Control and Prevention of HIV/AIDS and STIs

Outline the significance of CVT in the control and prevention of HIV/AIDS and STIs

VCT is an important tool for preventing the spread of HIV especially in communities where the epidemic is widespread. The following are the importance of counseling voluntary test:

It allows adolescents to find out their own HIV status in order to evaluate their behavior and its consequences.

VCT clinics usually have 45 minutes counseling sessions that provide information about HIV and AIDS and testing process

VCT can help improve advocacy and reduce stigma by giving people the opportunity to talk anonymously and confidentially with a counselor about their HIV status

The Procedures and Techniques of CVT for HIV/AID

Explain the procedures and techniques of CVT for HIV/AIDS

There are three main steps in VCT, as explained below:

First Step: There is a session of pre-test counseling where questions about HIV/AIDS and the test are discussed and answered by the counselor. The counselor will help the individual determine whether testing is appropriate given the information that is shared with them about the reason the individual wanted to be tested. Sharing information about their past sexual behaviors will help the counselor determine whether testing is appropriate. After making their assessment, if the counselor deems it appropriate for the person to take the test they should:

Describe the test and how it is performed

Explain AIDS and the way infection is spread

Discuss the ways to prevent the spread of HIV/AIDS

Explain the confidentiality of the test results

Discuss the meaning of the possible test results

Ask what impact you think the result of the test will have on them

Discuss whom they might share their results with

Discuss the importance of telling their sex partners and/or drug using partners if the result are positive

Second Step: When the person decided to have the HIV test they must sign a consent form before the test is administered. Informed consent is the crucial part of the VCT process and it is important that the individual is aware of their right to refuse any medical procedure, to be informed about it and to agree to it. There is a statement which they should be asked to read beforehand stating that they have been informed about the HIV-antibody test procedure, that they understand and have given their consent to have the test performed.

Third Step: After the test has been done, the counselor gives the results to the person in the post-test counseling session. (It usually takes around fifteen to twenty minutes after the test has been administered for the results to be ready). If they are found to be HIV positive (meaning that they have HIV) then they are referred to a medical specialist and other counselor in order to aid them in receiving treatment and support.