unwanted materials can be passed directly or indirectly to the outside complexity of the system increased with complexity of the body in

ASEXUAL REPRODUCTION

Cells are the basic structural and functional unit of organisms. Cells contain in nucleus in the cytoplasm. The nucleus controls all cellular activities. Living things have the ability to reproduce their kind, for the survival of the specie. There are two methods of reproduction

(1) Sexual reproduction in the production of new individuals with a combination of the hereditary information of two different cells i.e. gametes

(2) Asexual reproduction that is the formation of offspring without the union of gametes.

The following are the different types of asexual reproduction:

(a) Fission: This is most common among unicellular organisms. They divide into two roughly equal halves and grow to full size. The process is continuously repeated. Amoeba does it every 20-30 minutes. Merozoites of plasmodium exhibit multiple fission known as schizogony.

(b) Budeding: This is similar to fission but the parts are not equal e.g. yeast. A projection or bud develops at a portion of cell wall. The nucleus divides and one passes into buds. The bud can also bud before separating from parent. In hydra (multicellular), a projection of many cells from grows develop, tentacles and other adult features before pinching off. The tapeworm buds off mature proglottides. Rhizomes and stolon are found among plants. Miniature leaves are found in the margin of Bryophyllum.

(c) Sporulation: Formation of small bodies with nucleus and small cytoplasms. Terrestrial organisms have small and light spores with protective wall for easy dispersal the resistant wall keeps spores in protected and dormant state in unfavourable periods. Some bacteria are spore formers. In chlamydomonas, the cell content divides 1-3% to give 2 to 8 zaoospores, each with a nucleus and 2

flagella. Each grows to become adult. The fungi are prolific spore producers. The mosses, club mosses and ferns use spores to disperse.

(d) Fragmentation: The organisms breaks up into several parts. Each then regenerates all features of mature organism. Some annelids break into 8 or 9 parts which grow into adult. Fragmentation usually depends on external forces e.g. waves break up green and brown algae at sea shore spirogyra breaks to regenerate fragment lost. Man makes cuttings of plants to produce more.

In all forms of asexual reproduction, new cells (exact copies) are produced. The cells retain the hereditary blueprints of the parents. The blueprints are found in the nucleus residing on the chromosomes. They are distributed to daughter cells through the process of mitosis. Chromosomes are tenuous when not dividing (interphase) and are known as chromatins. They are active in RNA synthesis and shortly before mitosis, DNA systhesis. Mitosis is divided into 4 stages.

Prophase: The nucleolus disappear and chromosomes appear. The nuclear membrane disappears. Chromosomes coil up, becomes shorter and thicker. They appear double and joined at the centromere.

Metaphase: The spindle fibres extens between the poles of the cell attaching to individual centromeres. The centromeres arrange exactly on the equatorial plate.

Anaphase: Centromeres duplicate, separate and move to opposite poles.

Telophase: Chromosomes are at the poles, uncoil and coalesce. Nucleolus appear, nuclear membrane also. The cell plate appears at the equator and gradually a cell wall is secreted in plants. In animals, a furrow in the cell membrane forms at the equator to divide the cell.

(diagram)

The union of the two gametes (fertilization) in sexual reproduction results in new individuals. The gametes could appear similar, e.g. isogametes of Chlamydomonas. Individual chlamydomonas cells divide 4 or 5 to give 16 to 34 isogametes. The cell wall

breaks to release them and these fuse with the gametes of another cell to form a zygospore.

In most organisms, sperm i.e. the male gametes, are tiny consisting of little more than a nucleus and flagellum (which is used for movement to make contact with the egg). The female gamete, the egg, is larger and non motile with substantial quantities of cytoplasm for the developing embryo. Such gametes are said to be heterogametes. Fertilization of heterogametes gives zygote i.e. a fertilized egg. These involve 2 individuals combining to give new characteristics.

In hermaphrodites, both male and female gametes are produced by one individual e.g. Hydra, earthworm and most flowering plants. Usually two individuals are involved in producing the zygote. This promotes variability. A good example is found in Escherichia coli E. grows will in the presence of glucose and some inorganic salts. Some mutagenically treated ones (ultraviolet irradiation) are known. One strain is deficient in the ability to synthesize vitamin B, Biotin and amino acid. Methionine: Another strain produces the above but not the B vitamin; thiamine and amino acids; threomine and leucine. The two strains require the deficient substances to grow. But if both are mixed and plated on a medium colonies develop and survive even in the absence of the vitamins and amino acids their parents require to grow. This shows the simplest form of creation of variability. The mechanisms is not clear but in higher organisms the process of meiosis is implicated.

Meiosis: Each somatic cell of the species of organism contains diploid or 2^{nd} number of chromosomes representing the homologous pairs. If cells with diploid chromosomes were to serve as gametes, zygotes will have double the number of the parents. Meiosis corrects this by reducing the chromosome number in cells become gametes (germ cells) to half. It goes by duplicating an homologous pair and then separating into four daughter cells each with the haploid number of chromosomes. So that a zygote will have the 2^{nd} number.

1^{st} Meiotic Division: Prephase is slower and shorter synapsis occurs in each homologous paid and an exchange of parts between the members.

Metaphase: Centromeres of homologous pair are arranged on the equatorial plate and attached to the spindle.

Anaphase: Each centromere moves towards opposite poles. No duplication of members ocfcurs.

Telephase: Two daughter cells with a member of each homologous pair of chromosomes.2^{nd} Meiotic Division: Starts immediately or a little after 1 meoisis.

Prophase: Each chromosome is still a doublet with non-identical members.

Metaphase: Each chromosomes moves to the equatorial plate, attached to the spindle. They are duplicated.

Anaphase: Daughter chromosomes separate and move towards poles.

Telephase: Chromosomes are at the poles. Four daughter cells are produced with one member of a pair of chromosomes i.e. haploid. There are two cells with chromosomes of either of the parents and two with chromosomes containing both maternal and paternal parts.

When n = 2 we have 2 different combination (2^1)

n = 4 we have 16 different combinations (2^+) etc.

This random assortment coupled with crossing over, makes total similarly between two individuals quite different.

Meiosis reduces chromosome number and creates variability, even between two gametes of same individual.

Asexual reproduction produces offspring like parents while sexual reproduction produces variant offspring.

GAMETOGENESIS OR GAMETE FORMATION

Spermatogenesis:

Sperm cells or spermatogenia are produced by specialized cell in the gonads or testis. These are developed from the primordial germ cells which are diploid. Spermatogenia may divide to produce more or be transformed into primary spermtocytes after some growth. 1^{st} meiotic division follows to give secondary spermatocytes 2^{nd} meiotic division

occurs to give spermatids. Each spermatid differentiates into a spermatozoon with almost all cytoplasm lost.

Oogenesis

Eggs are produced in the ovaries. A primordial germ cell gives mitotically many oogonia. In aquatic organisms, division is once a year. In reptiles, birds and mammals, it stops long before birth. In human foetus, by 15 weeks, oogonia production is almost completed. Only one oogonial cell grow into a primary cocyte, surrounded by a layer of cell sin follicle. The others degenerate. At puberty, one egg (ovum) is released monthly. After release as primary cocyte, it undergoes 1st meiotic division. Secondary oocyte and small polar body are produced. The second meiotic division of the secondary cocyte gives the only functional egg (plus another polar body).

GAMETOGENESIS IN PLANTS

In plants, we have the sporophyte and the gametophyte generation. In angiosperms, the sporophyte is the dominant one while the gametophyte is greatly reduced in size. The male gametophytes are called microgametophyte while the females are megagametophyte. The males are found in the anther while the megagametophyte are in the ovary. The anther contains the pollen mother cell called microsporocytes which are diploid. Each undergoes meiosis I and II to give rise to four microspores which are haploid. Each spore nucleus undergoes metotic division without cytokinesis. One is the generative nucleus and the tube nucleus. This cell develops into pollen grains i.e. miucrogametophyte. After the pollen grain is placed on the stigma, the nuclei move into the pollen tube where the generative divides into 2 nuclei mitotically.

Megasporogenesis

Each ovule in plant contains the diploid megaspore mother cell or megasporocyte. The megasporocyte undergoes meiosis to give rise to 4-celled megaspores which are arranged in a linear order. Three of these degenerates leaving one which eventually becomes the megagametophyte. The nucleus undergoes 3 successive mitotic divisions

without cytokinesis to give a cell with 8 haploid nuclei. The cell is the embryo sac. Three of the 8 nuclei migrate to the chalaza and of the embryo sac (opposite to the opening 0 micropyle) and 3 to the micropylar end. The middle nuclei of the 3 at micropylar end becomes the functional egg and the two the synergids. Those at the chalaza end are called antipodal cells. They usually degenerate. The two at the centre are the polar nuclei. One of the two nuclei from the generative fuses with the egg and the other fuses with the remaining two cells to form the triploid endosperm.

GROWTH AND DEVELOPMENT

Growth is the increase in size of an organism arising from the synthesis of new structural material using the energy provided by respiration and raw materials from outside the organism.

During growth, the amount of cytoplasm generally increases, causing an increase in length, volume, area or weight of the organism.

Closely linked with growth is the process of development of an organism when cells differentiated into tissues and organs. Plants in their development may form seeds which germinate and show primary growth into roots, stems, leaves and flowers. Some plants may show secondary growth in trees. Animal development may show profound changes called metamorphosis seen in insects and amphibians. The overall growth of multicellular organisms is achieved by increase in the number of body cells as a result of cell division, this is accompanied by increase in size of individual cells by cell growth. When the rate of anabolism is greater than the rate of catabolism, the organism will show growth. When catabolism exceeds anabolism the organism will show a decrease in size and ultimately dies.

Patterns of growth in living organisms

The growth curve: Growth of both individuals and whpole populations tend to follow a sigmoid curve. This is one that starts slowly then increases to a maximum rate and then reaches an asymptote where no further change occurs. This curve can be interpreted mathematically by assuming that the rate of growth at any time is

proportional to the difference between the present weight and the final weight that will be attained. In the case of the growth of an individual the first phase is marked by an increase in cell numbers but not necessarily in whole size. The next phase is called the grand period of growth and here rapid increase in weight of the whole organism occurs. As maturity is reached the growth rate tails off and equilibrium is reached. The final stage of senescence is marked by decrease in weight as breakdown exceeds growth and this terminates in death.

In the case of many plants (especially annuals) e.g. maize there is a sharp decrease in weight following the production of seeds and flowers. This is also true of fishes such as the plaice and salmon.

Growth and form

Growth of many marine organisms such as lobsters and seaweeds tends to be unlimited and the organism continues to grow until its death. In land living species the more demanding nature of the environment produces a limited form of growth and increase of size ceases at a certain stage. Tree growth is theoretically unlimited (trees of at least 2000 years of age are known).

Metamorphosis

The fertilized eggs of most animals develop into an embryo which later grows into an adult. Other animals, amphibians and certain insects demonstrate considerable changes in body form between the fertilized egg and adult. Metamorphosis is the changes in body form of a larva or immature organism into an adult e.g. tadpole to frog and caterpillar to butterfly.

Incomplete metamorphosis

		Ecdysis
Egg	nymph	adult
	Sexually	moulting
	Immature	
	Lack wings	stages called instars

After the last moult is becomes sexually matured e.g. Locust, cochroaches

Complete metamorphosis

Housefly, moth, butterfly, mosquite, honey bees

Egg active larva pupa adult

Frog metamorphosis

A free tadpole larva emerges from the fertilized egg, attaching itself to a pond weed. It feeds on yolk food reserve and respire by external gills.

-A moth develops, allowing the free-swimming tadpole. Internal gills protected within an operculum cover replace external gills.

-Hindlimbs appear followed by forelimbs and the gills are replaced by lungs feeding halted whilst the tail is absorbed and a mouth and tongue develop, allowing a carnivorous diet to replace the herbivorous earlier diet.

Dormancy

A resting condition with a very low rate of metabolism in which growth ceases. Seen in seeds spores, buds, fruits and perennating organs such as bulbs, corms and tubers.

Dormancy is the means to survive adverse conditions of low temperature, lack of moisture in drought and watery conditions. Seeds may have variable dormancy periods lasting from one up to 100 years. Insects show a type of dormancy, eggs of human fleas remain dormant in floor board crevices, butterfly pupa hang dormant under ledges and adult houseflies cluster together in winter time in attic spaces. Amoeba encysts in time of drought and extremes of temperature.

Hibernation is a type of dormancy found in many different animals and is a means of survival over winter.

Growth regions

Plant

There are 3 main growth regions in flowering plants

(i) Cell division

(ii) Cell elongation

(iii) Cell differentiation region

Animals

The fertilized egg nucleus undergoes repeated mitosis to produce a mass of undifferentiated cells called a blastula. The cells differentiate and move into 3 main groups through a process called gastrulation

(1) endoderm future gut

(2) mesoderm future muscle and blood

(3) ectoderm future skin and nervous system

insects show intermittent growth in shedding the chitinous exoskeleton by ecdysis. Mammals including man demonstrate a type of growth where different body parts grow at different rates from the overall body growth rate. The human brain and eye grow more slowly than the arms and legs.

Growth measurement

(1) total fresh weight growth can be defined as the permanent increase in biomass, cell numbers or body size as a result of anabolic synthesis, cell division and cell expansion.

(2) Dry weight growth of an individual organism can be measured by the following methods

(3) Volume overflow can

(4) Photographs time lapse photography graphically growth in plants

Growth factors

(a) Genes

(b) Nutrition

(c) Chemicals and drugs carcinogenic chemicals e.g. tobacco tars, - cause cells to divide haphardly or produce neoplasms or cancer tumours in mammals. Antimitotic drugs slow down mitosis of cell nuclei and are used in treatment of cancer neoplasms. Thalidomide caused malformation of limbs in human

embryos, hindering their normal growth due to the drugs teratogenic or malforming effect.

(d) Light: Plants in shade or darkness grow tall and overcrowded plants tend to seek better positions facing the light. Mammals may be affected by not being able to form vitamin 'D in the skin resulting in abnormal growth or rickets in the young.

Enzymes Properties, Composition, types, mechanism of action

Classification

Enzayme are biological catalyst which accelerate or decelerate chemical reactions in living cells. They differ from inorganic catalysts because of their specificity and their not been able to withstand high temperature (50oC).

Enzymes are proteinous in nature and sometimes the proteins have non-protein parts attached to them. If the attachment between the protein and non-protein parts of an enzyme is tightly bonded by covalent bond; the non-protein part is called a prosthein group, examples being metals, like Cu, Mg, Fe. If the attachment between the protein and non-protein parts of an enzyme is loosely bonded by hydrogen bond, the non-protein part is called a co-enzyme or co-factor, examples being vitamins. The co-enzymes and prosthetic groups may become attached to several different proteins, thereby forming different