SUPPLEMENTARY MATERIAL
FOR
SENIOR SECONDARY BIOLOGY

National Curriculum for 2012 (Class XI & XII) has been revised under the aegis of COBSE in consensus with NCERT and CBSE.

In an effort to assist teachers to handle the revised curriculum, supplementary material has been prepared by experts at CBSE. The additional inputs have been proposed to motivate teachers to make conceptual linkages and create deeper interest in Biology.

CLASS XII-BIOLOGY

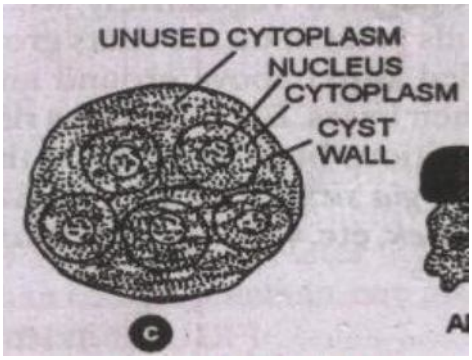
Unit VI

Chapter-1

Reproduction in organisms

Sporulation

When the products of multiple fission become individually surrounded by resistant coats, the cyst walls before their release from the parent, the processs is known as sporulation and the encysted products are termed spores. The spores remain inactive during unfavorable conditions such as dessication and extremes of temperature. When condition becomes favorable, the cyst hatches and gradually grows into an adult. Sporulation is thus not only a mean of reproduction, but also enables the organism to survive during unfavorable conditions and disperse to new localities with air. It occurs in amoeba.



Uniparental

It is the condition where a person receives two copies of a chromosome or part of a chromosome, from one parent and no copies from the other.

Fragmentation

Fragmentation is a form of asexual reproduction where an organism splits into fragments. Each of these fragments develops into mature fully grown individual followed by mitosis. it occurs in some algae (*Spirogyra*), fungi, some annelids and sea stars.

Regeneration

Regeneration is the process of renewal, restoration and growth. It can occur at the level of the cells, tissues and organs. It is common in Hydra, planarian flatworm and echinoderms. A lizard can discard a part of tail when in danger, and the tail can regenerate later. In humans too the liver can regenerate if partially damaged.

Unit VI- Reproduction

Chapter 2

Sexual Reproduction in Flowering Plants

Significance of seed and fruit formation

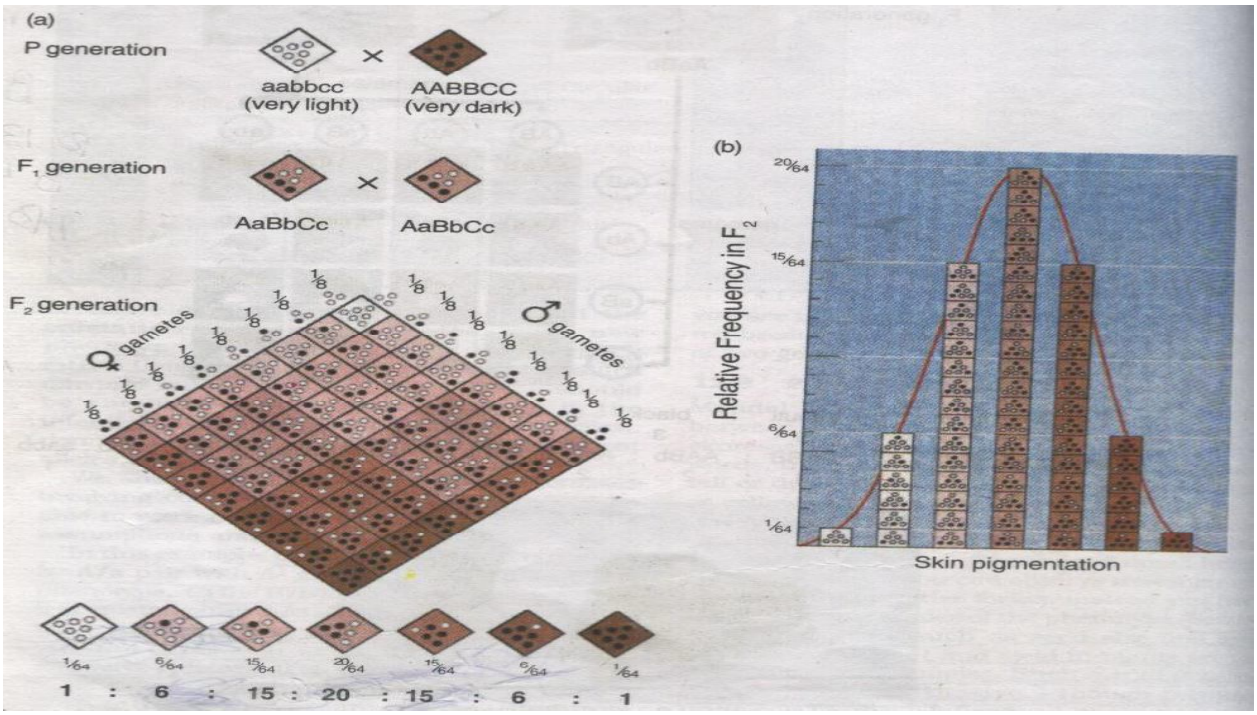
Significance of fruit formation

The fruits protect the seeds from unfavorable climatic conditions. Both fleshy and dry fruits help in the dispersal of seeds to distant places. They are a source of many chemicals like sugars, protein, oil, organic acids, vitamins and minerals. Some fruits may provide nutrition to the developing seedlings. Generally hard seeds are surrounded by soft fleshy fruit pericarp (for example guava) and soft seeds by a hard fruit shell (for example almond). The fleshy, edible parts of the fruit become the source of food and energy for the animals which often act as dispersal agents.

Polygenic Inheritance

Galton in 1883 suggested that many instances of continuous variation are heritable. He was impressed by the fact that taller human beings generally produce taller children. He suggested that characters such as height and mental capabilities in humans are heritable although these show a continuous range of variation in a population. Galton's postulate gained experimental support when it was found that at least in some instances the same

character can be determined by more than one gene, each with the same but cumulative phenotypic effect Quantitative characters like plant height, yield of crops (size, shape and number of seeds and fruits per plant), intelligence in human beings and milk yield in animals have been found to be determined by many genes and their effects have been found to be cumulative. Each gene has a certain amount of effect, and the more the number of dominant genes, the greater expression of the character. Quantitative inheritance is also known as polygenic inheritance or multiple factor inheritance. Though polygenic traits can be easily influenced by environment, these are generally controlled by three or more genes with phenotype reflecting the contribution of each allele (Quantitative). Let us discuss the polygenic trait by studying the inheritance of human skin colour. There are no contrasting phenotypes for this trait. Let us assume that this trait is controlled by three **genes A, B, and C. in this cross, there is a mating between dark-skinned and fair-skinned human beings and then the intermediate skin coloured individuals expected at F1 are mated to obtain F2 progeny.**



Polygenic inherence

(a) A cross depicting the inheritance of human skin colour controlled by polygenes.

(b) In the relative frequency of F_2 progeny in a polygenic cross is plotted against the extent of phenotypic expression – a typical inverted bell shaped curve is seen.

It is clear that:-

(i) Few individuals fall into parental categories;

(ii) The expression level of the phenotype is dependent upon the number of contributive alleles and is hence more quantitative.

If the F_2 data are plotted graphically, a bell-shaped curve results.
In this example, we have assumed the involvement of three gene pairs, However if higher number of genes are involved in determining a phenotype, greater variety would be expected in F_2generation.
Other examples that can be studied are the kernel colour in wheat and inheritance of cob length in maize. It is generally believed that during evolution there was duplication of chromosome or chromosome parts thereby leading to multiple copies of the same gene. A large number of characters are controlled by polygenes in which alleles contribute additively to a phenotype. This results in polygenic inheritance.

Unit VII

Chapter 5

Principles of Inheritance and Variation

Pleiotropy

Pleiotropism is defined as a phenomenon when single gene may produce more than one effect (the multiple effect of a gene) or control several phenotypes depending on its position.

The basis of Pleiotropy is the interrelationship between the metabolic pathways that may contribute towards different phenotypes. In phenylketonuria, mutation of a gene that codes for the enzyme phenyl alanine hydroxylase.

This results in a phenotypic expression characterized by mental retardation and a reduction in hair and skin pigmentation.

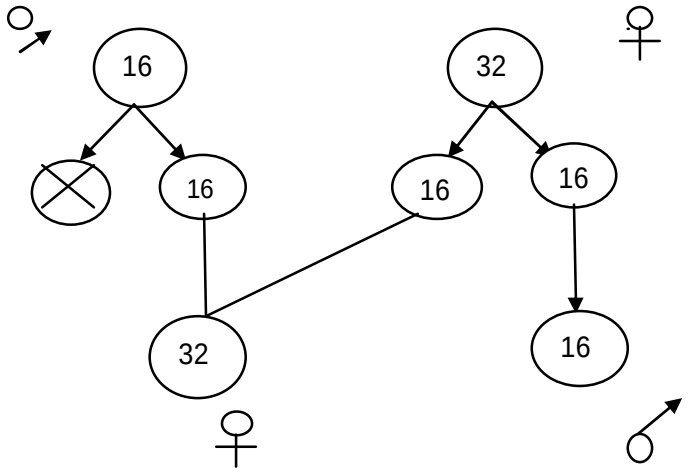
In drosophila white eye mutation leads to depigmentation in many other parts of the body, giving a pleitropic effect.

In transgenic organisms, the introduced gene can produce different effects depending on where the gene has introgressed.

Sex-determination in honey bee

The brood cells in a hive reveal two distinct sizes. The smaller of the two are reserved for the development of the workers, which are females, whereas the larger ones are for drones which are males. During the queen's nuptial flight, she is pursued by many drones. She finally allows herself to be inseminated by a drone. Sperms are stored in a seminal receptacle within her body. When she lays an egg in a worker cell, sperms are emitted from the seminal receptacle to fertilise the egg which will develop into a female, as all fertilised eggs form females (Incidentally, the workers can make this egg into a queen by enlarging the cell and feeding the developing larva on a rich diet, but both workers and queens are females.)

When the queen comes to a drone cell she exerts some sort of pressure on the ducts leading from the seminal receptacles so that the sperm cannot pass out and fertilise the egg as it passes down the oviduct. Thus an unfertilised egg is laid, which later hatches and produces a male. All unfertilized eggs produce males.

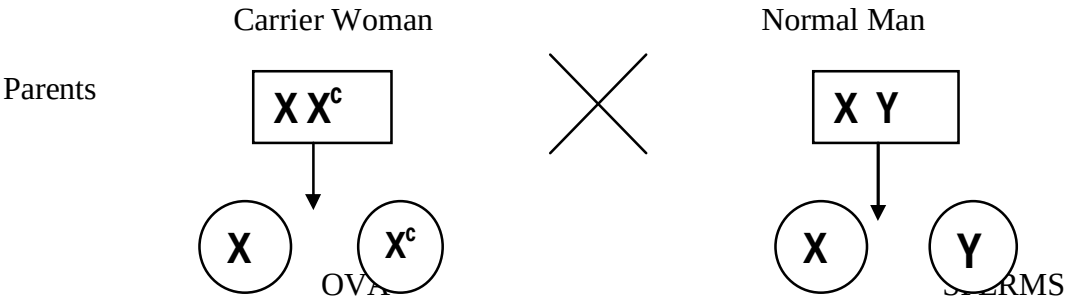


A diploid male could be obtained in the following manner. Suppose, there is a hetero zygous female X^a and X^z. When crossed with a male X^m,the females would be X^a/X^m and X^z/X^m. If the male with X^m is crossed with either of the females i.e. X^a/X^mor X^z/X^m then diploid male X^m/X^m. At the same time, the females would lay some infertile eggs which would hatch into normal, fertile, haploid males.

COLOUR BLINDNESS

Colour blindness is a recessive sex-linked trait in which the eye fails to distinguish red and green colours. The gene for normal vision is dominant. The normal gene and its recessive allele are carried by X-chromosome. In female colour blindness appears only when both the sex chromosomes carry the recessive gene (X^c X^c). The females have normal vision

but function as carrier if a single recessive gene for colour blindness is present (XX^C). However, in human males the defect appears in the presence of a single recessive gene (X^c Y) because Y chromosomes of males do not carry any gene for colour vision. Colour blindness, like any other sex-linked trait, shows criss-cross inheritance.



OFFSPRING

	X	Y
X	X Normal Girl	Normal Boy
X^c	X X^C Carrier Girl	X^c Y Colour Blind Boy

1 Normal Girl: 1 Carrier girl

1 Normal Boy: 1 Colour Blind Boy

Colour blindness

Colourblindness does not mean not seeing any colour at all, it means that those who are colourblind have trouble in seeing the differences between certain colours.

Most colourblind people can't tell the difference between red or green. That does not mean that they can not do their normal work - Infact they can also drive – they learn to respond to the way the traffic signal lights up-the red light is generally on the top and green is on the bottom.

THALASSAEMIA

Thalassaemia is a genetic defect, originated in Mediterranean region – by their mutation or deletion. In thalassaemia too few globins are synthesised whereas in sickle cell anaemia there is a synthesis of incorrectly functioning globin.

Thalassemias are a group of disorders caused by defects in the synthesis of globin polypeptide. Absence or reduced synthesis of one of the globin chains results in an excess of the other. In this situation free globin chains, which are insoluble, accumulate inside the red

cells and form precipitates which damage the cell, causing cell lysis and resulting in anemia. There are two main types of Thalassemias in which synthesis of $\propto$ or β globin is defective. It is common in Mediterranean, Middle East, Indian subcontinent and in south east Africa.

Alpha (α) Thalassaemia

The α Thalassaemias involve the genes HBA1 and HBA2, inherited in a Mendelian recessive fashion. There are two gene loci and so four alleles. It is also connected to the deletion of the 16p chromosome. α Thalassaemias result in decreased alpha-globin production, therefore fewer alpha-globin chains are produced, resulting in an excess of β chains in adults and excess γ chains in newborns. The excess β chains form unstable tetramers (called Hemoglobin H or HbH of 4 beta chains) which have abnormal oxygen dissociation curves.

Beta (β) Thalassaemia

Beta Thalassaemias are due to mutations in the HBB gene on chromosome 11 , also inherited in an autosomal-recessive fashion. The severity of the disease depends on the nature of the mutation. Mutations are characterized as (β^o or β Thalassaemia major) if they prevent any formation of β chains (which is the most severe form of β Thalassaemia); they are characterized as (β^+ or β Thalassaemia intermedia) if they allow some β chain formation to occur. In either case there is a relative excess of α chains, but these do not form tetramers: rather, they bind to the red blood cell membranes, producing membrane damage, and at high concentrations they form toxic aggregates.

Delta (δ) Thalassaemia

As well as alpha and beta chains being present in hemoglobin about 3% of adult hemoglobin is made of alpha and delta chains. Just as with beta Thalassaemia, mutations can occur which affect the ability of this gene to produce delta chains.

Unit VII

Chapter 7

Evolution

Evidence from embryology

Embryos of the vertebrate series exhibit many features that are not seen in adults. For example, all embryos of vertebrates develop a row of vestigial gill slits just behind the head. Since these

gill slits are functional only in fishes, why do these structures appear in the land vertebrates? It could mean that land vertebrates descended from fishes that had gill slits to help in aquatic respiration. Generalized features such as brain, spinal cord, axial skeleton and aortic arches are common to all vertebrates. Organisms that share common descent show embryological patterns on which they later build their adult patterns. This was first observed by von Baer Ernst Haeckel reinterpreted Baer's law in the light of evolution. This law held that ontogeny (development of the embryo) is recapitulation of phylogeny (development of race). This is summarized as biogenetic law which states that ontogeny recapitulates phylogeny. However, this proposal was disapprover on careful studies by von Baer as it was noted that the embryos do not pass through the adult stages of other animals. There are stages that related embryo to share.

Embryological evidence of evolution (adapted from NCERT)

Examples of this phenomenon are also seen in plants.

For example-

(i) The Protonema, an early stage in the development of moss or fern gametophyte, resembles the filamentous green algae in structure, physiology and growth pattern. This suggests an algal ancestry of bryophytes and pteridophytes.

(ii) The gymnosperms have normally become independent of water in fertilisation. However, the primitive gymnosperms such as Cycas and Ginkgo have flagellated sperms and need water for fertilization just like the pteridophytes, their most likely ancestors.

(iii) The seedlings of acacia tree initially develop simple leaves, but the leaves that develop later are compound.

Molecular evidence in Evolution

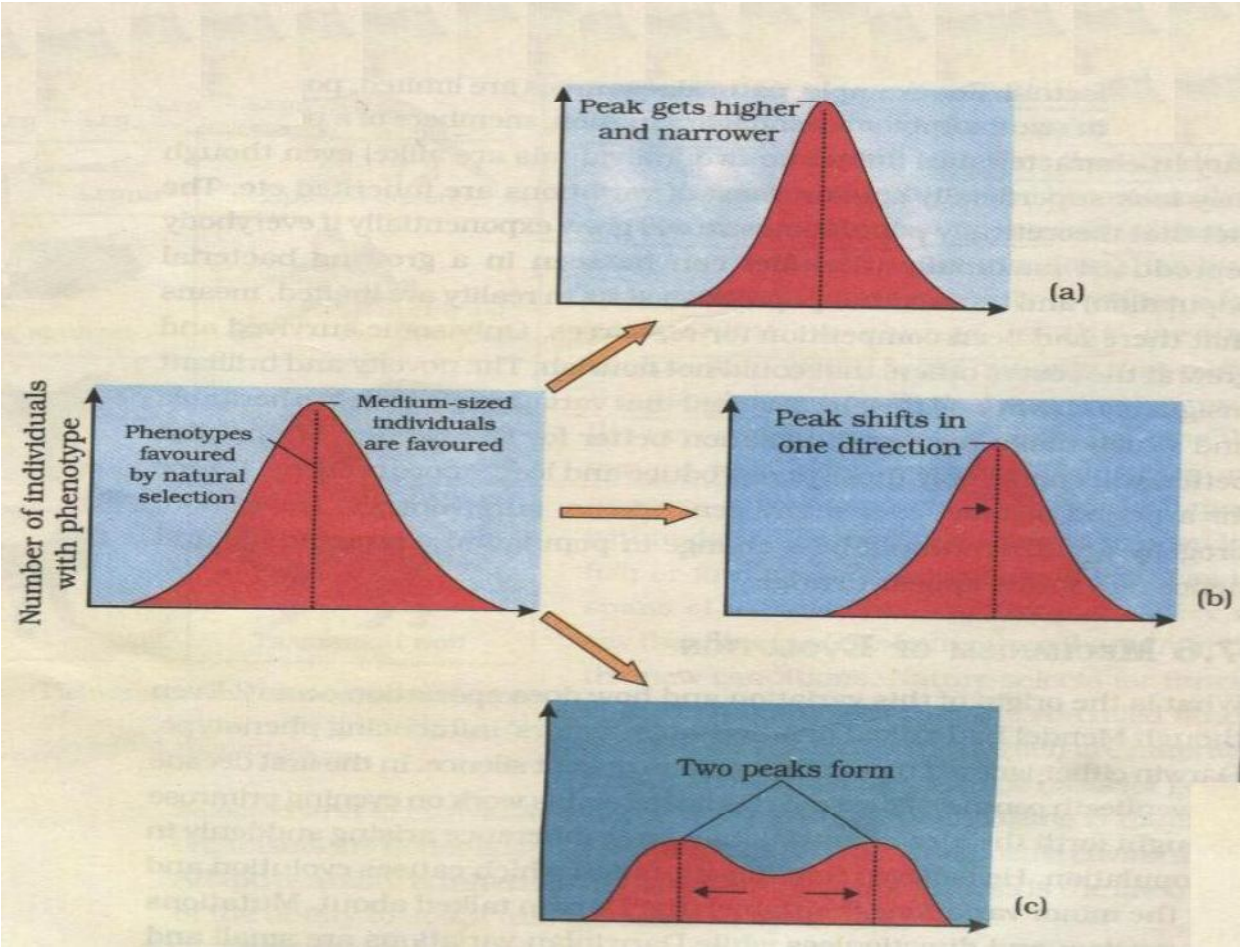
Similarity of organisms at the molecular level indicates phylogenetic relationship. The degree of similarity in the base sequence in their nucleic acids, and amino acid sequence in their proteins are indicated. Human DNA differs in only 1.8% of its base pairs from chimpanzee DNA, and there is no difference between the two in the amino acid sequence for the protein cytochrome C. Similarity in the molecular structure of actin and tubulin proteins in all animals point to their common ancestry.

A common genetic code is overwhelming evidence that all organisms are related.

MODERN SYNTHETIC THEORY OF EVOLUTION

Darwinism, the theory of natural selection has a wide acceptance. However, it has been criticised too, on the ground it could not explain how the variations arise. With progress in genetics, the sources of variation were explained and Darwin's theory was modified. Now, the most accepted theory of evolution is known as **SYNTHETIC THEORY OF EVOLUTION**, in which the origin of species is based on the interaction of genetic variation and natural selection.

Types of Natural Selection



Diagrmatic representation of the operation of natural selection on different traits (a)Stabilising (b)Directional (c)Disruptive - adapted from NCERT

Natural selection causes allele frequencies of a population to change. Depending upon which traits are favoured in a population it can produce three different results.

(1) Stabilizing selection - If both the smallest and largest individuals contribute relatively fewer offspring to the next generation than those closer to average size do, then stabilizing selection is operating. It reduces the variation but does not change mean value.
(2) Directional selection – If individuals at one extreme of the size distribution e.g. (the larger ones) contribute more offspring to the next generation then the other individuals do, then the mean size of individuals in the population will increase. In this case directional population is operating. If directional selection operates for many generations, an evolutionary trend within the population results.
(3) Disruptive selection- When natural selection simultaneously favours individuals at both extremes of the distribution, disruptive selection is operating. As a result we can see two peaks in the distribution of a trait.

UNIT - IX

CHAPTER 12

BIOTECHNOLOGY AND ITS APPLICATIONS

Patent

A set of exclusive rights granted by a state (national government) to an inventors or their assignee for a limited period of time in exchange for a public disclosure of an invention.

Patents are supposed to satisfy three criteria of : Novelty, non-obviousness, and Utility.

Novelty implies that the innovation must be new. It cannot be part of 'prior art' or existing knowledge. Non-obviousness implies that it may not be documented but is otherwise well known. The discored fact or product should be of a particular use for the human beings.

Controversies in India regarding patent and biopiracy

Turmeric: In May, 1995 the US Patent Office granted to the University of Mississippi Medical Center a patent for "Use of Turmeric in Wound Healing."

Consider the implication of 'turmeric patent'. If an Indian in America sprinkles turmeric powder – just as her ancestors in India have done for centuries – on her child's scrape, she would in fact be infringing US patent laws and would be open to prosecution.

The patent was promptly challenged by Dr. R A Mashelkar, an Indian scientist who has done much to awaken India to Intellectual property Rights issues. After four months of submissions it was established that the use of turmeric as a healing agent was well-known in India for centuries. The patent was revoked.

Neem: In 1996, Vandana Shiva challenged the patent ranted to the firm of W.R. Grace & Co. by the European Patent Office, Munich for 'fungicidal uses of neem oil'. Although the patent has been granted on an extraction technique, the Indian press described it as a patent on the neem tree itself: the result was widespread public outcry, which was echoed throughout the developing world. Vandana Shiva and Ajay phadke, who had researched neem in India, flagged ancient Indian texts to point out that there was on 'novelty' factor in neem's magical properties that Grace & Co. had unveiled – Indians had known them for long. Legal action by the Indian government followed, with the patent eventually being overturned in 2005.

Basmati Rice: In September 1997, a Texas company called Rice Tec won a patent on "basmati rice lines and grains." The patent secured lines of basmati and basmati-like rice and ways of selecting that rice for breeding. Rice Tec, owned by Prince Hans-Adam of Liechtenstein, international outrage over allegations of biopiracy. It has also caused a brief diplomatic crisis between India and United States with India threatening to take the matter to WTO (World Trade Organization) as a violation of TRIPS (trade-related aspects of intellectual property rights) which could have resulted in a major embarrassment for the United States. Both voluntarily, and due to review decisions by the United States patent Office, Rice Tec lost most of the claims of the patent.

UNIT – X

CHAPTER 13

ORGNISMS AND POPULATION

Niche

A habitat can contain many ecological niches and support a variety of species. The ecological niche of an organism represents the range of conditions that it can tolerate, the resources it utilizes, and its functional role in the ecological system. Each species occupies a distinct niche, and no two species are believed to occupy the same niche.