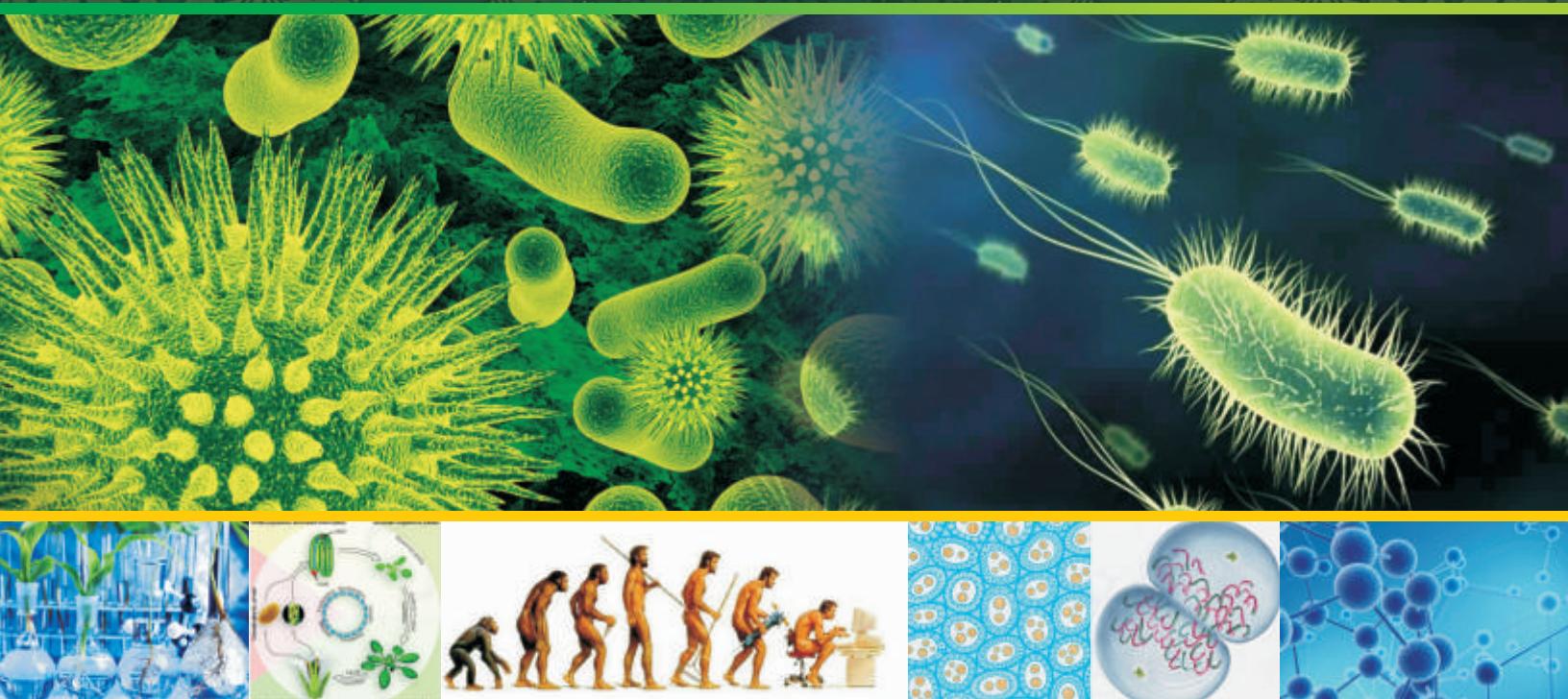


# *Biology (044)*

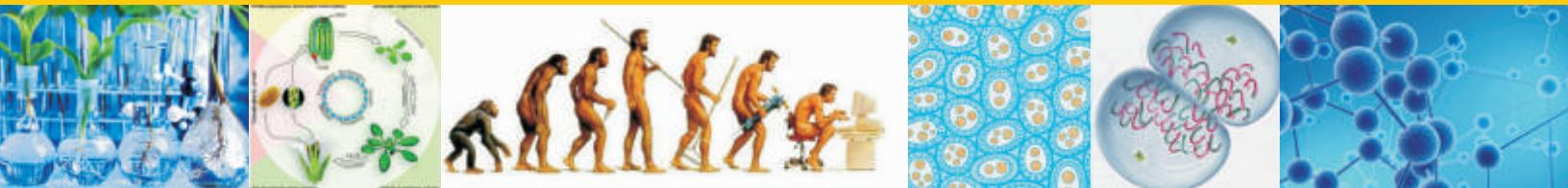
## **SUPPLEMENTARY MATERIAL [REVISED]**



**CENTRAL BOARD OF SECONDARY EDUCATION**  
Shiksha Kendra, 2, Community Centre, Preet Vihar, Delhi-110 092 India

# Biology (044)

**SUPPLEMENTARY MATERIAL**  
**[REVISED]**



**CENTRAL BOARD OF SECONDARY EDUCATION**  
Shiksha Kendra, 2, Community Centre, Preet Vihar, Delhi-110 092 India

## भारत का संविधान

### उद्देशिका

हम, भारत के लोग, भारत को एक '[ सम्पूर्ण प्रभुत्व-संपन्न समाजवादी पंथनिरपेक्ष लोकतंत्रात्मक गणराज्य ]' बनाने के लिए, तथा उसके समस्त नागरिकों को:

सामाजिक, आर्थिक और राजनैतिक न्याय,  
विचार, अभिव्यक्ति, विश्वास, धर्म  
और उपासना की स्वतंत्रता,  
प्रतिष्ठा और अवसर की समता

प्राप्त कराने के लिए, तथा उन सब में, व्यक्ति की गरिमा और [ राष्ट्र की एकता और अखण्डता ] सुनिश्चित करने वाली बंधुता बढ़ाने के लिए दृढ़संकल्प होकर अपनी इस संविधान सभा में आज तारीख 26 नवम्बर, 1949 ईं को एतद्वारा इस संविधान को अंगीकृत, अधिनियमित और आत्मार्पित करते हैं।

1. संविधान ( बयालीसवां संशोधन ) अधिनियम, 1976 की धारा 2 द्वारा ( 3.1.1977 ) से "प्रभुत्व-संपन्न लोकतंत्रात्मक गणराज्य" के स्थान पर प्रतिस्थापित।
2. संविधान ( बयालीसवां संशोधन ) अधिनियम, 1976 की धारा 2 द्वारा ( 3.1.1977 से ), "राष्ट्र की एकता" के स्थान पर प्रतिस्थापित।

### भाग 4 क

### मूल कर्तव्य

51 क. मूल कर्तव्य - भारत के प्रत्येक नागरिक का यह कर्तव्य होगा कि वह -

- (क) संविधान का पालन करे और उसके आदर्शों, संस्थाओं, राष्ट्रध्वज और राष्ट्रगान का आदर करे;
- (ख) स्वतंत्रता के लिए हमारे राष्ट्रीय आंदोलन को प्रेरित करने वाले उच्च आदर्शों को हृदय में संजोए रखे और उनका पालन करे;
- (ग) भारत की प्रभुता, एकता और अखण्डता की रक्षा करे और उसे अक्षुण्ण रखें;
- (घ) देश की रक्षा करे और आहवान किए जाने पर राष्ट्र की सेवा करे;
- (ङ) भारत के सभी लोगों में समरसता और समान भ्रातृत्व की भावना का निर्माण करे जो धर्म, भाषा और प्रदेश या वर्ग पर आधारित सभी भेदभाव से परे हों, ऐसी प्रथाओं का त्याग करे जो स्त्रियों के सम्मान के विरुद्ध हैं;
- (च) हमारी सामाजिक संस्कृति की गौरवशाली परंपरा का महत्व समझे और उसका परीक्षण करे;
- (छ) प्राकृतिक पर्यावरण की जिसके अंतर्गत वन, झील, नदी, और वन्य जीव हैं, रक्षा करे और उसका संवर्धन करे तथा प्राणिमात्र के प्रति दयाभाव रखें;
- (ज) वैज्ञानिक दृष्टिकोण, मानववाद और ज्ञानार्जन तथा सुधार की भावना का विकास करे;
- (झ) सार्वजनिक संपत्ति को सुरक्षित रखे और हिंसा से दूर रहें;
- (ञ) व्यक्तिगत और सामूहिक गतिविधियों के सभी क्षेत्रों में उत्कर्ष की ओर बढ़ने का सतत प्रयास करे जिससे राष्ट्र निरंतर बढ़ते हुए प्रयत्न और उपलब्धि की नई उंचाइयों को छू ले।

# THE CONSTITUTION OF INDIA

## PREAMBLE

**WE, THE PEOPLE OF INDIA**, having solemnly resolved to constitute India into a <sup>1</sup> **SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC** and to secure to all its citizens :

**JUSTICE**, social, economic and political;

**LIBERTY** of thought, expression, belief, faith and worship;

**EQUALITY** of status and of opportunity; and to promote among them all

**FRATERNITY** assuring the dignity of the individual and the <sup>2</sup> [unity and integrity of the Nation];

**IN OUR CONSTITUENT ASSEMBLY** this twenty-sixth day of November, 1949, do **HEREBY TO OURSELVES THIS CONSTITUTION.**

1. Subs, by the Constitution (Forty-Second Amendment) Act. 1976, sec. 2, for "Sovereign Democratic Republic (w.e.f. 3.1.1977)
2. Subs, by the Constitution (Forty-Second Amendment) Act. 1976, sec. 2, for "unity of the Nation (w.e.f. 3.1.1977)

# THE CONSTITUTION OF INDIA

## Chapter IV A

### Fundamental Duties

## ARTICLE 51A

### **Fundamental Duties - It shall be the duty of every citizen of India-**

- (a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;
- (b) to cherish and follow the noble ideals which inspired our national struggle for freedom;
- (c) to uphold and protect the sovereignty, unity and integrity of India;
- (d) to defend the country and render national service when called upon to do so;
- (e) To promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;
- (f) to value and preserve the rich heritage of our composite culture;
- (g) to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures;
- (h) to develop the scientific temper, humanism and the spirit of inquiry and reform;
- (i) to safeguard public property and to abjure violence;
- (j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement.



## **BIOLOGY (044)**

### **SUPPLEMENTARY MATERIAL**

#### **(REVISED)**

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 in 2012 which is revised 2014 by experts at CBSE. The additional inputs have been proposed to motivate teachers to make an understanding about topics added recently to bring about equivalence with advancements in the field and to make conceptual linkages and create deeper interest in the subject of Biology.

# Acknowledgements

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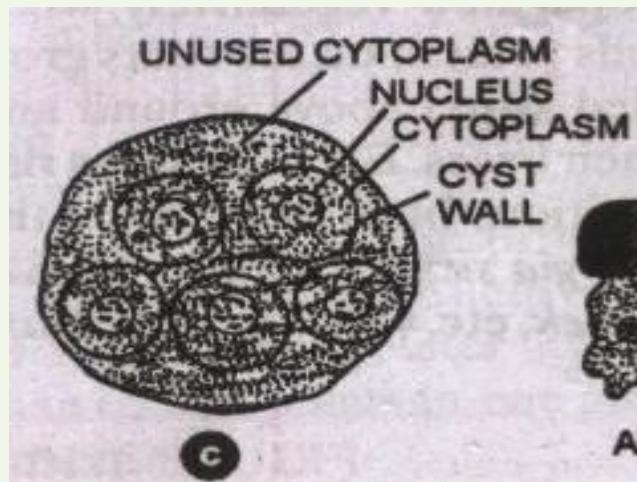
Ms. Deepa Shukla, Consultant, CBSE

**CLASS-XII**  
**Unit-1**  
**Reproduction in Organisms**

### **Sporulation**

When the products of multiple fissions get individually surrounded by resistant coats, before their release from the parent, the process is known as sporulation and the encysted products are termed as spores.

The spores remain inactive during unfavorable conditions such as dessication and extreme of temperature. When conditions become favorable, the cyst hatches and gradually grows into an adult. Sporulation is thus not only a mean of reproduction, but also enables the organisms to survive during unfavorable conditions and disperse to new localities with air. It occurs in many organisms.



### **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 flatworms 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.

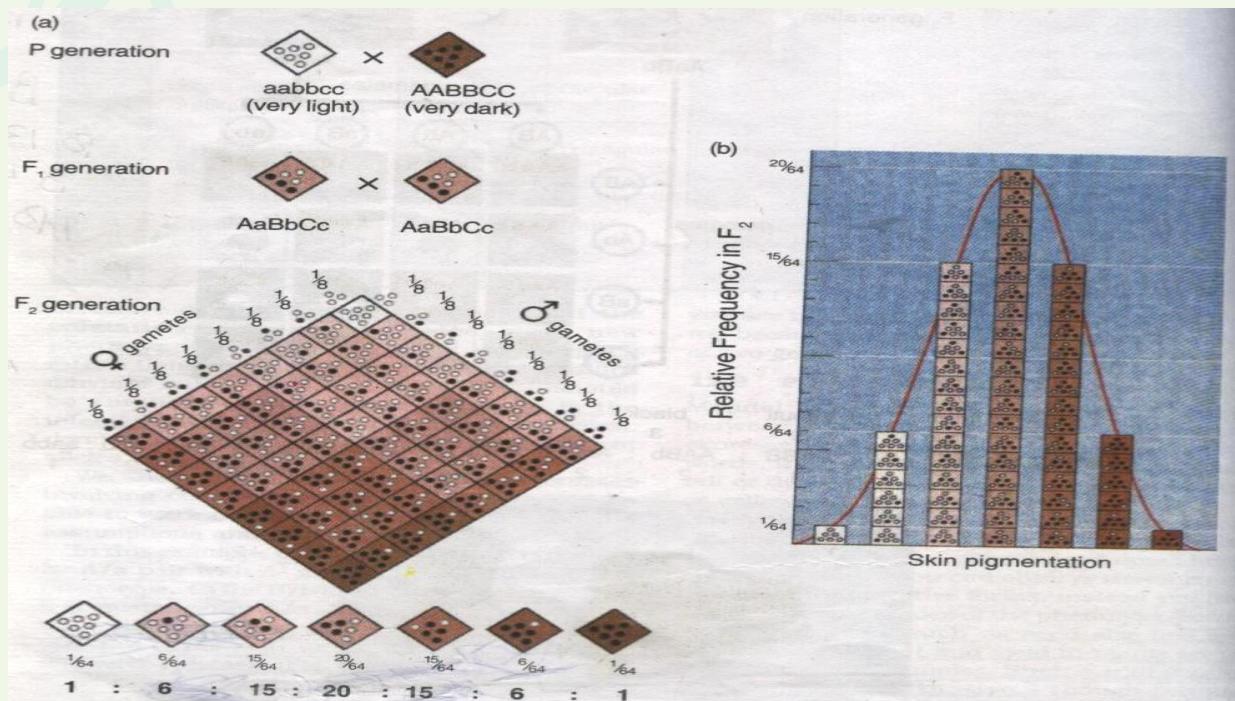
## **Sexual Reproduction in Flowering Plants**

### **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. The more is the number of dominant genes, the greater will be the 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 obtained in F<sub>1</sub> are mated to obtain F<sub>2</sub> progeny.



### Polygenic Inheritance

- (a) A cross depicting the inheritance of human skin colour controlled by polygenes
- (b) In the relative frequency of F<sub>2</sub> 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 hence it is more quantitative.

If the F<sub>2</sub> data is 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<sub>2</sub> generation.

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 results in 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-2

### Principles of Inheritance and Variation

#### **Pleiotropy**

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

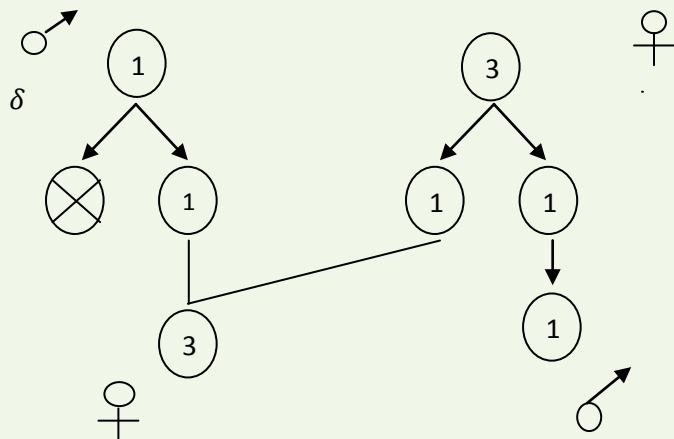
The basis of Pleiotropy is the interrelationship among various metabolic pathways that may contribute towards different phenotypes. In phenylketonuria, mutation of that gene takes place which codes for the enzyme phenyl alanine hydroxylase. This results in a phenotypic expression characterized by mental retardation and reduction in hair and skin pigmentation.

In drosophila, white eye mutation leads to depigmentation in many other parts of the body, giving it a pleitropic effect. In transgenic organisms, the introduced gene can produce different effects depending on where the gene has introduced.

#### **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, it is pursued by many drones. It finally allows herself to be inseminated by a drone. Sperms are stored in a seminal receptacle within her body. When it lays an egg, sperms are emitted from the seminal receptacle to fertilize the egg which will develop into a female, as all fertilized eggs form females (incidentally, the workers can convert 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).

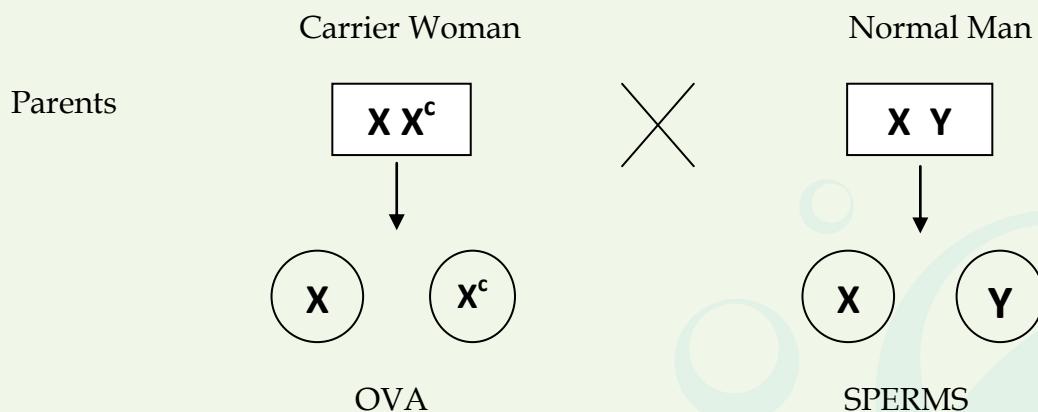
The queen, it exerts some sort of pressure on the ducts leading from the seminal receptacles so that the sperms cannot pass out and fertilize the egg as it passes down the oviduct. Thus an unfertilised egg is laid, which later hatches and produces a male. All unfertilized eggs produce males.



A diploid male could be obtained in the following manner. Suppose, there is a heterozygous 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.  $X^a/X^m$  or  $X^z/X^m$ , then diploid male  $X^m/X^m$  can be obtained in the progeny. At the same time, the females would lay some unfertilized 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 alleles are carried by X-chromosome. In females, colour blindness appears only when both the sex chromosomes carry the recessive alleles ( $X^c X^c$ ). 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.



Offsprings

	X		Y
X	X X Normal Girl	X Y Normal Boy	
X <sup>c</sup>	X X <sup>c</sup> Carrier Girl	X <sup>c</sup> Y Colour Blind Boy	

1 Normal Girl: 1 Carrier Girl

1 Normal Boy: 1 Colour Blind Boy

Colourblindness does not mean the blindness for every colour, it means that those who are colourblind have trouble in seeing the differences between certain colours.

Most colourblind people cannot differentiate between red and green colour. That does not mean that they cannot do their normal work, in fact they can drive also. They learn to respond to the way the traffic signal lights up as the red light is generally on the top and green is on the bottom.

### **Thalassemia**

Thalassemia is a genetic defect, originated in Mediterranean region, by the mutation of genes by addition or deletion. In thalassemia 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  $\alpha$  or  $\beta$  globin is defective. It is common in Mediterranean, middle east, Indian subcontinent and in south east Africa.

### **Alpha ( $\alpha$ ) Thalassemia**

The  $\alpha$  Thalassemias 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.  $\alpha$  Thalassemias result in decreased alpha-globin production, therefore fewer alpha-globin chains are produced, resulting in an excess of

$\beta$  chains in adults and excess  $\gamma$  chains in newborns. The excess  $\beta$  chains form unstable tetramers (called Hemoglobin H or HbH of 4 beta chains) which have abnormal oxygen dissociation curves.

### Beta ( $\beta$ ) Thalassemia

Beta Thalassemias 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 ( $\beta^0$  or  $\beta$  Thalassaemia major) if they prevent any formation of  $\beta$  chains (which is the most severe form of  $\beta$  Thalassaemia); they are characterized as ( $\beta^+$  or  $\beta$  Thalassaemia intermedia) if they allow some  $\beta$  chain formation to occur. In either case there is a relative excess of  $\alpha$  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 ( $\delta$ ) Thalassemia

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

### Dengue

The dengue virus (DENV) in one of five serotypes is the cause of dengue fever. It is a mosquito-borne single positive-stranded RNA virus of the family Flaviviridae; genus Flavivirus. All four serotypes can cause the full spectrum of disease. Dengue is transmitted by several species of mosquito within the genus Aedes, principally A. aegypti. They typically bite during the day, particularly in the early morning and in the evening, but they are able to bite and thus spread infection at any time of day all during the year.

The reason that some people suffer from more severe forms of dengue, such as dengue hemorrhagic fever, is multifactorial. Different strains of viruses interacting with people with different immune backgrounds lead to a complex interaction.

Flaviviruses, especially dengue virus has the ability to inhibit the innate immune response during the infection. Indeed, the dengue virus has many nonstructural proteins that allow the inhibition of various mediators of the innate immune system response.

Symptoms include fever, headache, muscle and joint pains (also known as breakbone fever) and a characteristic rash that is similar to measles. In a small proportion of cases the disease develops into the life-threatening dengue hemorrhagic fever, resulting

in bleeding, low levels of blood platelets and blood plasma leakage, or into dengue shock syndrome, where dangerously low blood pressure occurs. There is leakage of plasma from the blood vessels which typically lasts one to two days. This may result in fluid accumulation in the chest and abdominal as well as depletion of fluid from the circulation and decreased blood supply to vital organs. There may also be organ dysfunction and severe bleeding, typically from the gastrointestinal tract.

Prevention depends on control of and protection from the bites of the mosquito that transmits it. The primary method of controlling A. aegypti is by eliminating its habitats. This is done by getting rid of open sources of water, or if this is not possible, by adding insecticides or biological control agents to these areas.

### **Chikungunya**

Disease is caused by Chikungunya virus

It is an RNA virus that belongs to the alphavirus

Chikungunya is a viral disease transmitted to humans by infected mosquitoes. It causes fever and severe joint pain. Other symptoms include muscle pain, headache, nausea, fatigue and rash. It features sudden onset fever usually lasting two to seven days, and joint pains typically lasting weeks or months but sometimes years.

The virus is transmitted from human to human by the bites of infected female mosquitoes. Most commonly, the mosquitoes involved are Aedes aegypti and Aedes albopictus, two species which can also transmit other mosquito-borne viruses, including dengue. These mosquitoes can be found biting throughout daylight hours, though there may be peaks of activity in the early morning and late afternoon. Both species are found biting outdoors, but Ae. aegypti will also readily feed indoors. Prevention and control relies heavily on reducing the number of natural and artificial water-filled container habitats that support breeding of the mosquitoes. This requires mobilization of affected communities. During outbreaks, insecticides may be sprayed to kill flying mosquitoes, applied to surfaces in and around containers where the mosquitoes land, and used to treat water in containers to kill the immature larvae.

For protection during outbreaks of chikungunya, clothing which minimizes skin exposure to the day-biting vectors is advised.

### **Molecular Basis of Inheritance**

### **Rice Genome Project**

Rice Genome: It is a joint project of National Institute of Aerobiological Sciences (NIAS), forestry and fisheries (STAFF), Ministry of Agriculture, Forestry and Fisheries (NAFF),

Society for Techno-innovation of Agriculture genome research program. Gene is a "Blueprint of life."

Rice has the smallest genome of 430Mbps.

- Genomics: It is the study of genetic content of an organism. Genome of plants or animal has information about gene and thus transcribed DNA.

#### **Features:**

- Worlds first genome crop which is completely sequenced
- Arabidopsis is an experiment plant of rice genome

Rice is taken as experiment crop because

- It belongs to grass family
- It has smaller genome and high diversity
- It has co-linearity with wheat, barley and maize

#### **Application:**

- Large varieties / number of rice mutants had been developed artificially.
- It helps in enhancing the molecular products.
- Rice genomics is an international open access committed to serve rice genome research.

## **Unit-3** **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 characters, 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 disapproved on the basis of careful studies by Von Baer as it was noted that the embryos do not pass through the adult stages of other animals.

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 fertilization. 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**

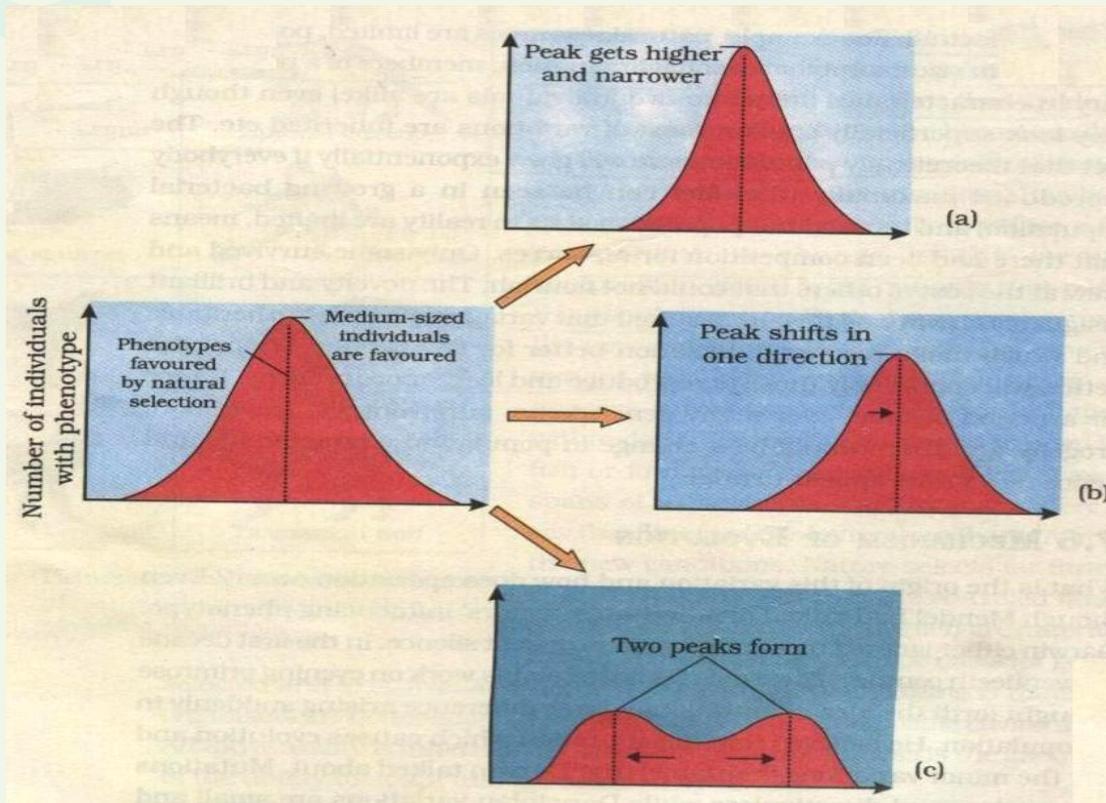
Similarity of organisms at the molecular level indicates phylogenetic relationship. The degree of similarity in the base sequence in their nucleic acids, and amino acid sequence in their proteins are indicated. Human DNA differs in only 1.8% of its base pairs from chimpanzee DNA, and there is no difference 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 to.

### **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



Diagrammatic 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, then stabilizing selection is considered to be 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 than the other individuals, then the mean size of individuals in the population will increase. In this case directional selection is operating. If directional selection operates for many generations, an evolutionary trend within the population results.
- (3) Disruptive selection – When natural selection simultaneously favors 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.

## **Antibiotics**

### **Definition**

An antibacterial medication that destroy or slow down growth of bacteria are known as Antibiotics.

Antibiotics are used to cure infection caused by bacteria. The first natural antibiotic discovered by Alexander Fleming is Penicillin in 1928. Antibiotics - Anti means against, bios mean life, e.g. ampicillin, penicillin etc.

### **How do Antibiotics Work**

Antibiotics prevent multiplication of bacterial population allowing hosts to fight against infection, which is done by stopping the mechanism responsible for building cell wall.

### **Judicious use of Antibiotics**

- 1) Antibiotics help to fight against various diseases.
- 2) Antibiotics kill a larger group of pathogens.
- 3) Antibiotics cause no damage to the host.
- 4) Antibiotics not cause any allergic reaction to the host.
- 5) Antibiotics kill pathogen before they mutate and become resistant to it.

### **Basic classes of Antibiotics**

- β-Lactams (penicillins)
- Aminoglycosides (gentamycin)
- Quinoloues (ciprofloxacin)
- Sulfonamides (Sulfamett oxazole)
- Glycopeptides (vanomycin)

### **Choice of regimen**

Antibiotics are oral as well as parenteral

### **Disadvantage of antibiotics**

- 1) Excessive use of antibiotics is harmful to health
- 2) These do not work against virus
- 3) Excessive use of antibiotics leads to development of resistance in bacteria.

## **Antibiotics and their judicious use**

The US National Library of Medicine says that antibiotics-powerful medicines that fight bacterial infections- can save lives when used properly. "Judicious use" is using a drug appropriately and only when necessary. With reference to antibiotics, judicious use implies using an antibiotic only when indicated and prescribing optimal dose and duration of the antimicrobial. There is concern worldwide that antibiotics are being overused. Antibiotic overuse is one of the factors that contribute towards the growing number of bacterial infections which are becoming resistant to antibacterial medications. The development of resistance to medically important drugs, and the resulting loss of their effectiveness, poses a serious public health threat. Misuse and overuse of antimicrobial drugs allows resistant bacteria (the hard-to-kill "bad bugs") to increase in numbers faster than susceptible bacteria (the easy-to-kill bugs) and can transfer through the food chain to humans. This increases the opportunity for people to become infected by resistant (bad bug) bacteria.

Common forms of antibiotic misuse include self prescription of antibiotics, excessive use of prophylactic antibiotics in travelers and failure of medical professionals to prescribe the correct dosage of antibiotics on the basis of the patient's weight and history of prior use, failure to take the entire prescribed course of the antibiotic, incorrect dosage and administration, or failure to rest for sufficient recovery. Inappropriate antibiotic treatment, for example, is their prescription to treat viral infections such as the common cold.

If antibiotics are used too often for things they can't treat – like colds, flu or other viral infections – not only are they of no benefit, they become less effective against the bacteria they're intended to treat.

Not taking antibiotics exactly as prescribed also leads to problems. For example, if you take an antibiotic for only a few days – instead of the full course – the antibiotic may wipe out some, but not all, of the bacteria. The surviving bacteria become more resistant and can be spread to other people. When bacteria become resistant to first line treatments, the risk of complications and death is increased.

Other consequences are the increased costs associated with prolonged illnesses, including expenses for additional tests, treatments and hospitalization.

Factors that contribute to antibiotic overuse include lack of education and patients' expectations. Multifaceted interventions are needed to reduce unnecessary antibiotic use; peer education and feedback on doctors' use of antibiotics can promote behavior

change. Educational interventions for the public should include a public relations campaign with simple messages, clinic based patient education, and community outreach activities. Educational messages should be directed on the following themes-

- a. Education regarding common diseases and the role of antibiotics
- b. Education to promote adherence to the prescribed treatment
- c. Efforts to increase awareness of antibiotic resistance and its impact on individuals and society.

## UNIT-4

### BIOTECHNOLOGY AND ITS APPLICATIONS

#### **Stem Cell Technology**

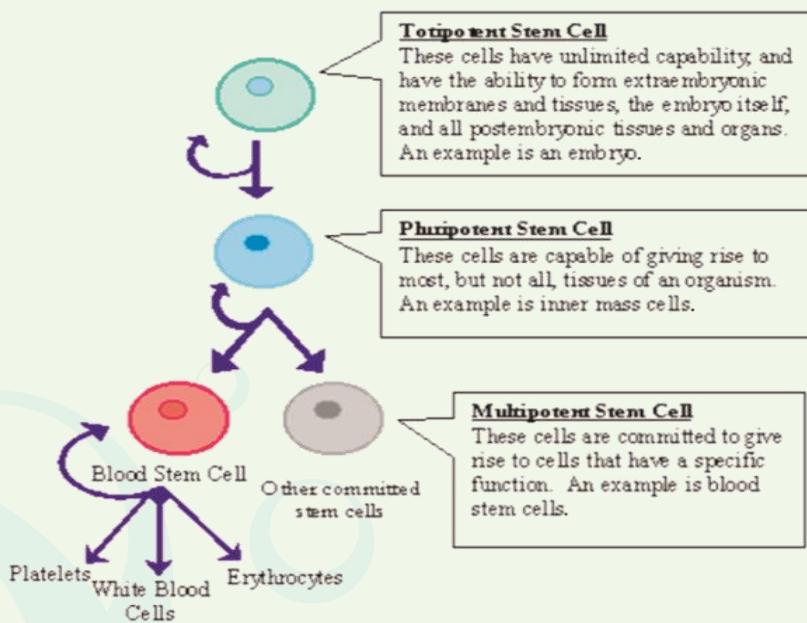
##### **Stem Cell**

A cell has ability of self renewal i.e. to divide and differentiate into any kind of tissues/cell. These cell are used in developing different human tissues.

##### **Characteristics**

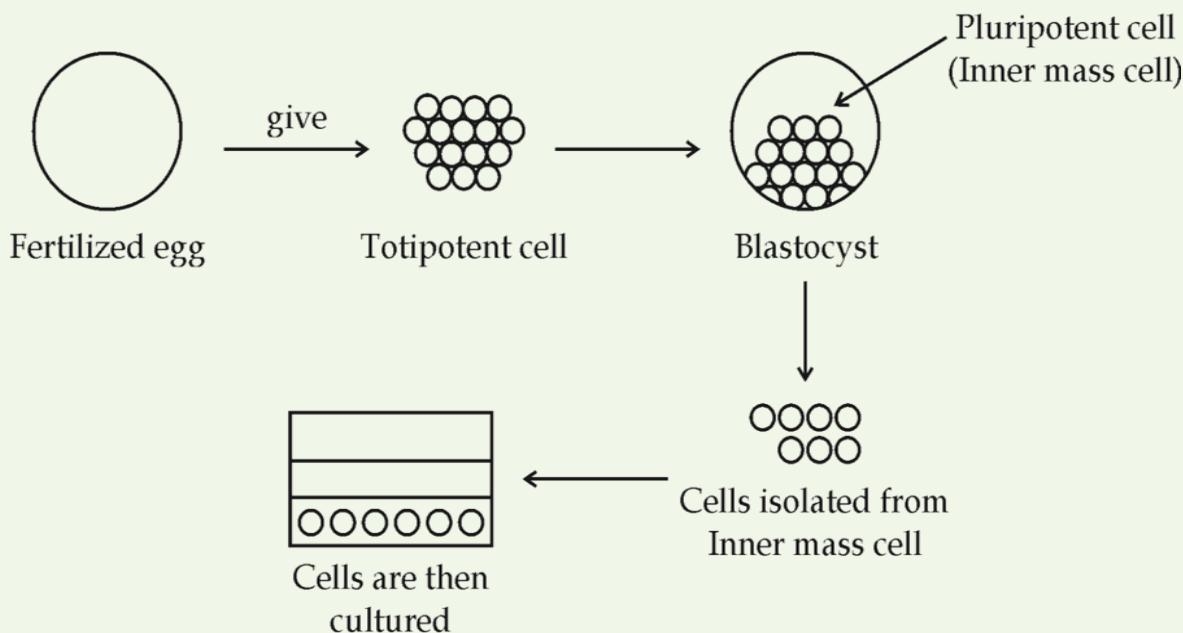
- 1) They have the ability to divide and renew themselves
- 2) Cells after division give rise to specialized cell types

##### **Stem Cell Differentiation**



## Kinds of Stem cells

- 1) **Embryonic stem cells:** These are extracted from five to six months old embryo and they have the ability to form any type of cells in human body.
- 2) **Adult stem cells:** There are undifferentiated cells among differentiated cells. Their ability to divide are described as they can divide into few types cell.
- 3) **Embryonic germ cells:** These are derived from human embryo that produce egg or sperm.



Fertilized egg provides totipotent cells, then they form pluripotent cells. Pluripotent cells are then isolated from inner mass cell then they are cultured in laboratories and these cells give rise to different cells / tissues. These cells lead to formation of different organs and their organs are transplanted if patient suffer from any disease or deficiency.

## Applications

- 1) Stem cell technology is useful in treatment diseases e.g. diabetes, spinal cord injury, heart disease etc.
- 2) Genetic disease e.g. cystic fibrosis can be treated by this.
- 3) Through tissue repair, different disease can be treated by this technology.
- 4) Adult bone marrow are injected in heart arteries to improve cardiac functions.
- 5) Injection of stem cells reduces pancreatic cancer.

- 6) Stem cells are also helpful in rheumatoid arthritis.
- 7) Stem cells are guided to form pancreatic islets cell to secrete insulin to cure diabetes.
- 8) These are also used in restoration of vision.

### **Patent**

A set of exclusive rights granted by a state (national government) to inventor 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 discovered fact or product should be of a particular use for human beings.

### **Controversies in India regarding patent and Biopiracy**

**Turmeric:** In May, 1995 the US Patent Office granted a patent to the University of Mississippi Medical Center 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 no '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, has been 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-5**

### **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.

#### **Ramsar Convention**

Ramsar convention is an international treaty for the conservation and utilization of wetlands, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific and recreational value.

Ramsar convention was signed in 1971. Australia was one of the 1<sup>st</sup> country to sign Ramsar convention. It was named after the city Ramsar in Iran.

Under Ramsar convention, a wide variety of natural and human-made habitat types ranging from river to coral reefs can be classified as Ramsar wetlands. Wetlands include marshes, lakes, coral reefs, etc.

#### **Ramsar Sites**

Ramsar convention encourages the designation of sites containing wetlands that are important for conserving biological diversity. Ramsar convention broadly aims to conserve worldwide loss of wetlands and this can be conserved by wise use and management of water resources. This requires policy making, technology transfer etc.

Ashtamudi wetland (Kerala), Bhitarkanika Manaroues (Orissa), Bhojcutland (Madhya Pradesh), Chandra Taal (Himachal Pradesh) etc. are some of the Ramsar sites. Indian wetlands are of intervention importance under Ramsar convention.

All joining parodies of the Ramsar convention commit themselves to work towards the "three pillars" of the convention:

- Ensuring the conservation and wise use of wetlands
- Including as far as possible the wise use of all wetlands in national environment planning
- Consulting with other parties about the implementation of the convention, especially in regard to transboundary wetland, shared water system and shared species

### **Climate Change**

Change in weather patterns due to global warming lasts for an extended period of time. Climate change is caused by factors such as biotic processes, variations in solar radiation, plate tectonic exercise pollution and volcanic eruption certain human activities are also identified as significant causes of climate change.

Unwanted cutting of forest, ongoing constructions, increased use of CFC, CH<sub>4</sub>, CO etc. are leading towards global warming. Due to cutting of forests CO<sub>2</sub> level is increasing in the atmosphere, this CO<sub>2</sub> forms a blanket which does not allow harmful radiation to radiate out, this causes increase in temperature, which ultimately causes climate change in long term, after global warming its immediate effect.

### **Implications**

- Melting of ice in lower coastal regions causes flooding in their area
- Temperature is increasing
- Droughts are affecting many areas
- Biodiversity is getting affected adversely
- Sea levels are rising
- Wildlife is at alarming risk
- Causing economic losses e.g.: Fishing business and many more effects

## **Climate Impacts on human health**

- 1) Heat waves lead to heat stroke, dehydration, excessive heat causes deaths. Urban areas are typically warmer than outer area. Increased demand of electricity in summer to run air conditioners causes increase in air pollution, green house gas emissions. e.g.: Los Angles, annual deaths are projected to increase two seven folds by the end of 21<sup>st</sup> century.
- 2) Reduces availability of fresh food and water
- 3) Increases stomach aches, mental health problem, PTSD (Post-traumatic stress disorder) etc.
- 4) Ground level ozone damages lung tissue, reduces lung function and causes inflammation. This also causes asthma and lung diseases.
- 5) Climate change causes allergies and adversely affects respiratory health.
- 6) Climate change leads to spread of diseases like food-borne diseases, water borne diseases, animal borne disease etc.

## **CLASS-XI**

### **Unit-1**

#### **Biological Classification**

**Five kingdom classification:** It is based on complexity of organisms and types of nutrition. The five kingdoms are Monera, Protista, Mycota, Plantae and animalia.

**Six kingdom classification:** It is proposed by Carl Woese who has suggested a separate kingdom for Archaebacteria that are included in Monera in Whittaker's five - kingdom classification.

**Three domains of life:** These are Archaea, Bacteria and Eukarya. Archaea has kingdom Archaebacteria, Bacteria has kingdom Eubacteria and Eukaryota has kingdoms - Protista, Mycota, Plantae and Animalia.

### **Unit-4: Plant Physiology**

#### **Plant Growth and Development**

##### **Seed Germination**

The first step in the process of plant growth is seed germination. The seeds germinate under favourable conditions of the environment. Some seeds undergo a period of dormancy and can germinate only after dormancy period gets over.

Seed germinates to from seedling which grows into a plant. After the dormancy of the seed is over or is broken, and the necessary conditions for germination are available, the dormant embryo becomes metabolically active and starts growing. This process is known as seed germination. The conditions necessary for seed germination are availability of water and oxygen. The imbibitions or the uptake of water is the first step towards the germination of seed. It causes swelling of seed that ruptures the seed coat to enable the radical to emerge from one end of embryonic axis with the other. The metabolic activities require oxygen for breaking down the food reserves. The mobilization of food reserves involves the hydrolysis of stored polysaccharides, proteins, and lipids with the help of enzymes.

The emergence of radical which gives rise to root system is considered as the first step towards seed germination. As radical emerges from one end of the embryonic axis, plumule, which forms the shoot, arises from the other end. The rate of respiration

increases rapidly during seed germination. The growth of radical and plumule is due to the cell extension, cell division and initiation of several biochemical processes. The seed also needs a suitable temperature (optimum between 25 to 35).

Some plants such as Rhizophora and Sonneratia show special type of germination known as vivipary. These plants grow in marshy lands. Vivipary is the germination of a seed while it is still attached to the parent plant and is nourished by it. As the germinating seed forms a seedling, its weight increases and the seedling separates and falls down into the mud. The lateral roots then develop to help proper anchorage of the seedling.

### **Seed Dormancy**

The development of embryo stops once the seed matures. It sheds most of its water content, the metabolic activities become extremely low, the seed coat becomes impermeable to oxygen and moisture and it usually hardens.

In many plants, the seed undergoes a period of suspended growth and does not germinate as soon as it is formed. The suspension of growth is referred to as quiescence when it is due to exogenous factors, such as the environmental conditions. The seeds may be in a state of dormancy or rest due to endogenous control during which metabolic activity of the seed is greatly reduced. While quiescence is the condition of a seed when it is unable to germinate because the conditions for germination are not available, dormancy is the condition of seed when it is unable to germinate in spite of the availability of all environmental conditions suitable for germination.

Dormancy in seeds may be due to impermeable or mechanically resistant seed coats, rudimentary or physiologically immature embryos and even due to the presence of germination inhibitors such as abscisic acid, phenolic acid, short chain fatty acids and coumarin. Dormancy of the seed can be broken, or its duration can be reduced to initiate germination, by mechanical or chemical scarification of the seed coat, stratification of seeds or changing environmental conditions such as temperature, light and pressure.

Scarification of seed involves scratching of seed coat to help break the dormancy caused by hard and impermeable seed coat. Stratification of seeds is subjecting the moist seeds to oxygen for variable periods of low or high temperatures.

## Unit-5: Human Physiology

### Digestion and Absorption

#### **Calorific value of carbohydrates, proteins and fats**

We all recognize the vital importance of food for life. A certain part of the nutrients that we take is used for building cell structures, synthesize functional molecules or replace worn-out parts. However most of the food is used as source of metabolic fuel. Carbohydrates, proteins and fats serve as the chief sources of energy in humans. These are oxidized and transformed into ATP, the chemical energy formed used by cells to drive their multitudes of activities.

Since heat is the ultimate form of all kinds energies, the energy value of food (or any fuel) is expressed in terms of a measure of heat energy it produces on combustion. The heat energy released by combustion of one gram of food is usually known as its **gross calorific value**. It is defined as the amount of heat produced in calories (cal) or in joules (J) from complete combustion of 1 gram food in a bomb calorimeter (a closed metal chamber filled with O<sub>2</sub>). The calorific value is usually expressed in terms of kcal per gram or kilojoules per gram (1kcal = 4.184kJ). One kilocalorie is the amount of heat energy needed to raise the temperature of one kilogram of water through 1°C (1.8°F). Nutritionists traditionally refer to kcal as the **Calorie** or to kJ as **Joules** (always capitalized). The calorific values of carbohydrates, proteins and fats are 4.1 kcal/g, 5.65 kcal/g and 9.45 kcal/g, respectively. The actual amounts of energy liberated in the body by these nutrients, referred to as the physiologic value of the food, and are 4.0 kcal/g, 4.0 kcal/g and 9.0 kcal/g respectively.

#### **Deficiency diseases**

Humans require a wide range of nutrients to perform various functions in the body and to lead a healthy life. You have already learnt about the functions of various nutrients in previous classes. Inadequate nutrients in the diet cause various deficiency disorders, particularly among the children and the poor.

The important deficiency disorders include protein energy malnutrition (PEM) and disorders due to deficiencies of Vitamin A, iron and iodine. Deficiency of protein and energy or both, called PEM, has been identified as major health and nutritional problems in India. Protein and energy intake are difficult to separate because diets adequate in energy are adequate in protein. Young children (0-6 years) require more protein for each kilogram of body weight than adults. So they are more vulnerable to

malnutrition. Malnutrition is not only an important cause of childhood mortality and morbidity, but it also leads to permanent impairment of physical and mental growth of those who survive. The details of the disorders are given below –

**PEM:** It is an important nutritional problem among pre-school children.

It leads to various degrees of growth retardation. This is due to lack of adequate quantity of protein or carbohydrate or both.

PEM is of 2 types: Kwashiorkor and Marasmus

Deficient Nutrient	Name of Deficiency	Deficiency Symptoms
Protein (PEM)	Kwashiorkor (usually observed in children in the age group of 1-5 years)	Wasted muscles, thin Limbs, retarded growth of body and brain, swelling of legs due to retention of water (oedema), reddish hair, pot belly and diarrhoea.
Protein and Calorie (PEM)	Marasmus (it usually affects infants below the age of one year)	Impaired growth and replacement of tissue proteins, thin limbs and prominent ribs (emaciated body), dry, wrinkled and thin skin, diarrhoea.

The child suffering from PEM can recover if adequate quantity of protein and carbohydrate rich food is given.

### Excretory Products and their elimination

#### Diabetes Insipidus

Antidiuretic hormone (ADH) is one of the hormones that efficiently monitors and regulates the functioning of the kidneys. Can you recall the other hormones involved? Why is ADH so called? (Diuresis is urine production.) Antidiuretic hormone released from the posterior pituitary, prevents wide swings in water balance, helping to avoid dehydration or water overload. Try to recollect how ADH facilitates reabsorption of water by the distal parts of the kidney tubules and thereby prevents diuresis. Deficiency of ADH leads to *diabetes insipidus*, a condition marked by the output of huge amount of

urine and intense thirst. The name itself (*diabetes*=overflow; *insipidus* = tasteless) distinguishes it from diabetes mellitus (*mel*=honey), in which insulin deficiency causes large amounts of blood sugar to be lost in the urine.

### **Artificial kidney**

You have studied about various disorders of the excretory system. Hemodialysis is an artificial process of removing toxic substances from the blood in patients of kidney failure. The hemodialysis machine is therefore also known as the artificial kidney.

## **Locomotion and Movement**

### **Types of movements: Flagellar movement**

Movement is a basic characteristic of living organisms. There are three main types of movements shown by the cells of the human body, viz amoeboid, ciliary and muscular. Human sperms (typical example of flagellated cells) exhibit yet another type of movement, the flagellar movement. The flagellum is the propulsion equipment for the movement of sperms towards the ovum. This propulsion is brought about by the whip like movement of the tail and the middle piece of the sperm.

## **Neural control and coordination**

### **Sense organs**

Humans are responsive organisms. Aroma of a freshly cooked dish makes our mouth water, loud thunder makes us jump on our seat and stepping on a nail causes intense pain. We sense the changes in our environment (both internal and external) with the help of special sensory receptors. These environmental changes, called stimuli, once detected by the special sensory cells, are conveyed to the brain in the form of nerve impulses. The meaning of each stimulus is interpreted in the brain and appropriate order is sent to the body parts for its appropriate response to ensure well being.

Traditionally, there are five senses; touch, vision, hearing, smell and taste. While touch is a complex **general sense**, the other four are **special senses**. The general sensory receptors are **simple receptors** that are mostly modified dendritic ends of sensory neurons. Such receptors are present throughout the body, in the skin, mucous membranes, connective tissues and muscles. These monitor most of the types of general sensory information such as tactile sensation (a mix of touch, pressure, stretch and vibration), heat, cold, pain and muscle sense (proception).

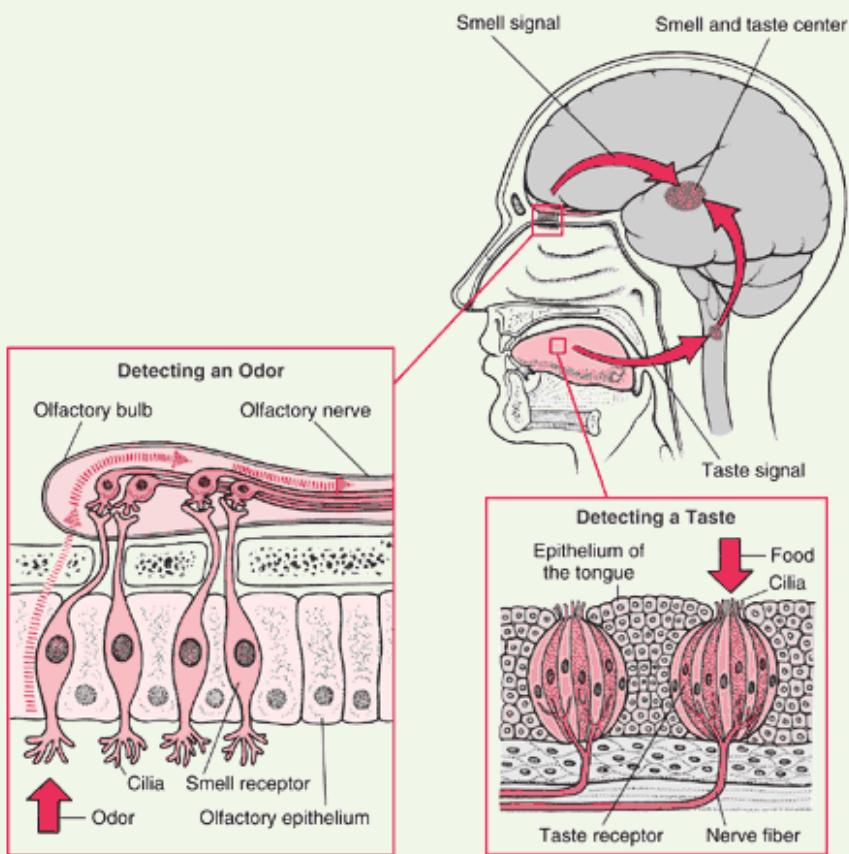
In contrast, special sensory receptors are distinct receptor cells that are actually confined to the head region and are highly localized within complex sensory organs like eyes and ears and tissues of the taste buds and olfactory epithelium. These sensory organs and tissues are collection of cells of different types (receptor and non receptor cells), working together to accomplish a specific receptive process. Recall the structure of eye and ear that you have studied. Which type of sensory receptor are these made of? The special sensory receptors called the photoreceptors and the auditory receptors respectively.

Though the complex sense organs are more familiar to us, the simple sensory receptors associated with general senses are no less important. These keep the central nervous system well informed about what is happening, both deep within the body and on its surface. In this lesson you will learn about a few of these simple receptors present in the skin. You will also learn about the special senses of taste and smell.

### The chemical senses: Taste and smell

The receptors for taste and smell are classified as chemoreceptors as these respond to special chemicals in aqueous solution. In each case, the chemicals must go into solution in the film of liquid coating the membranes of the receptor cells, before these can be detected. The taste receptors are specialized cells that detect chemicals present in the mouth itself, while smell receptors are modified sensory neurons in the nasal passage which detect the volatile chemicals that get wafted up the nostrils from distant sources. These two types of receptors complement each other and often respond to the same stimulus. You can now guess why a very strong perfume leaves a peculiar taste in your mouth. The smell receptors can be as much as 3,400 times more sensitive than the taste receptors.

**Sense of smell (olfaction):** Nose contains the receptors of smell, in the mucous coated thin, yellowish patch (about  $5\text{cm}^2$ ) of modified pseudostratified epithelium called **olfactory epithelium**. It is located at the roof of the nasal cavity on either sides of the nasal septum.



*Human nose showing olfactory bulb and magnified view of olfactory epithelium*

[smsm2a2012.weebly.com/reading-site.html](http://smsm2a2012.weebly.com/reading-site.html)

The olfactory epithelium contains three types of cells: (a) millions of olfactory receptor cells; (b) columnar supportive cells; (c) short basal cells. Olfactory receptors are unusual bipolar sensory neurons. The thin dendrites of each of these neurons run to the surface of the epithelium where these bear a cluster of about 20 modified cilia which function as receptor sites. These cilia extend from the olfactory epithelium into the thin coat of nasal mucous secreted by the supportive cells and olfactory glands. This mucous is a solvent that captures and dissolves the air borne odour molecules. Once dissolved, the chemicals bind to the specific receptors on the cilia stimulating the receptor cells. This causes depolarization and ultimately action potential in the receptor cell. The axons of the olfactory receptors unite to form the olfactory nerve which transmits the information directly to the overlying olfactory bulb, a relay station in the brain. Unlike receptor ends of other senses, the axons of the olfactory receptors directly extend from the outside environment (the nasal cavity) into the olfactory bulb, a part of the brain. The number of receptors stimulated indicates the strength of the stimulus.

As with the tastes, some of the smells, can be really painful. The nasal cavity contains pain receptors that respond to irritants such as ammonia, vinegar or hot chili pepper. Impulses from these pain receptors reach the brain. The brain combines these sensations with those of smell to identify the odours. Although humans do have a good sense of smell - we can detect about 10,000 different odours - our olfactory capability is not as good as those of many other vertebrates, especially fish and mammals such as a dog.

### Sense of taste (Gustation)

The sense of taste and smell work together very closely. If we cannot smell something, we cannot taste it either. When we speak of taste sensations we are often referring to the combined sensation produced by both taste and smell receptors. One reason why we cannot taste (or smell) food well with a common cold is that, with the nasal passages inflamed and coated with thick mucus layer, the smell receptors are practically non functional. The receptor cells for taste are located in **taste buds**. Humans have about 10,000 taste buds. The majority of taste buds are located in pockets around the papillae (peg-like projections of the mucous membrane) on the surface and sides of the tongue, but there are some on the surface of the pharynx and the larynx. Each taste bud contains about 40 specialized receptor cells or **gustatory cells**, many others are supporting cells and some basal cells that replace the worn out cells of the taste buds. Unlike the receptors for smell, that are modified sensory neurons, the receptor cells for taste are not neurons, but these are specialized cells with slender microvilli on their outer ends. The microvilli protrude into the surrounding fluids through a narrow opening called **taste pore**. Dissolved chemicals, contacting the microvilli, bind to specific receptor proteins on the microvilli, and thereby depolarizes the cell. The dendrites of the associated sensory neurons, coil intimately around the receptor cells and synapse with them so that, when a receptor cell is stimulated and depolarized, it releases neurotransmitter which leads to the generation of an action potential in the associated sensory neuron. Each dendrite receives signals from several receptor cells within the taste bud. Nerve fibers emerging from the taste buds pass to the brain stem. From here the nerve impulse is relayed to the taste centre in the cerebral cortex of the brain that perceives the taste sensation.

Normally our taste sensations are complicated mixtures of qualities. In humans, there are four basic taste senses; sweet, sour, salt, and bitter. The receptors for these four basic tastes have their areas of greatest concentration on different parts of the tongue - sweet and salty on the front, bitter on the back, and sour on the sides. A few substances stimulate only one of the four types of receptors, but most stimulate two, three, or all

four types to varying degrees. The sensation and flavour of the food we experience, is thus produced by a combination of these four basic sensations, modified by accompanying sensations of smell, texture and temperature.

### Sense of touch

Skin is the sensory organ for touch and is also the largest sense organ. Our sense of touch allows us to feel even a small sensation like the touch of a feather as well as a heavy sensation like a stone falling on the toe. These sensations come from millions of microscopic simple sensory receptors located all over the skin and associated with the general sensations of contact or pressure, heat, cold, and pain. The receptors are located at different levels within the skin and distributed unevenly. Some parts of the body have a large number of these such as the finger tips, making them more sensitive. Can you name the parts of your body that are less sensitive and why are they so?

Structurally, these touch receptors are either free dendritic endings or encapsulated dendritic endings present in the skin (and other parts of the body). When stimulated, they transmit the sensation to the brain.

Given below are some of these receptors present in the skin -

Free or bare dendritic nerve endings are present throughout the epidermis taking an extensive branching or 'zigzag' form. These respond chiefly to pain and temperature but some respond to pressure as well. The root hair plexuses, network of free nerve endings that surround hair follicles, are light touch receptors that detect bending of hair. They report on wind blowing through your hair.

Meissner's corpuscles are small receptors in which a few spiraling dendrites are surrounded by specialized capsule (Schwann) cells. These are found just beneath the skin epidermis in dermal papillae and are especially abundant in finger tips and soles of the feet. These are light pressure receptors that allow us to become aware of feel of our shirt against our skin.

Pacinian corpuscles are the large egg shaped bodies. In each, a single dendrite is surrounded by multilayers of capsule cells. These are scattered deep in the dermis and in the subcutaneous tissue of the skin. These are stimulated by deep pressure and respond only when pressure is applied. Thus, these receptors are best suited to monitor vibrations (on-off pressure stimulus). The sense of touch allows us to detect different textures, temperatures, hardness and pain. Pain serves as a warning or alert system for the body. Whenever one or more of these sensory receptors are stimulated (by heat, cold, vibrations, pressure or pain) an impulse or action potential is generated. This

impulse is then taken to the spinal cord and from there to the brain which analyses the stimulus and then generates appropriate response. The way brain interprets the sensation in our lives, is also shaped by our personal experience in the past. Try to recollect your experience of touching a sharp object/a hot plate by accident.

### **Chemical coordination and integration**

#### **Exophthalmic Goiter**

It also called Grave's disease. It is an endocrine disorder that is the most common cause of hyperthyroidism. In Grave's disease excessive secretion of thyroxine hormone is accompanied by diffused enlargement of the thyroid gland. It is an autoimmune disease where patients produce antibodies that act on the thyroid glands to increase thyroxine hormone production and thyroid size. Patients, suffering from cancer of thyroid glands or those with nodules in the thyroid gland, suffer from very high levels of thyroid hormones leading to hyperthyroidism. Such patients show some typical symptoms that include elevated metabolic rate, sweating, rapid and irregular heartbeat, weight loss despite increased appetite, frequent bowel movement and nervousness. Some patients may also experience exophthalmos (or protrusion of the eye balls). Thus this condition is also known as exophthalmic goitre. Do you recollect another condition that may also lead to goitre (enlargement of the thyroid glands)? Lack of iodine in our diet also results in goitre which, however, is associated with hypothyroidism and not hyperthyroidism.

#### **Addisons' disease**

The cortex of the adrenal glands secretes many hormones, commonly called as corticoids. Hyposecretory disorder of the adrenal cortex or destruction of adrenal cortex in diseases such as tuberculosis leads to deficit of both glucocorticoids and mineral corticoids. This condition is known as Addison's disease. Persons with Addison's disease tend to lose weight, their blood glucose and sodium levels drop and potassium level rises. Can you explain why? Severe dehydration is also common in them.



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