# 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 XI- BIOLOGY

# UNIT - I

# Chapter -2

# Biological Classification

**Five kingdom classification** is based on complexity of organism and type of nutrition. The five kingdoms are:

Monera, Protista, Mycota, Plantae and animalia.

**Six kingdom classification:** proposed by Carl Woese who has suggested a separate kingdom for Arachaebacteria that are included in Monera in Whittaker's five - kingdom classification in addition to the five kingdom classification of R.H.Whittaker.

**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 IV-Plant Physiology

# Chapter 15

# Plant Growth and Development

**Seed Germination**

The first step is 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 seeding 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 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 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 to35).
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 manyplants, 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 environments 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 V- Human Physiology

## Chapter 16

## **Digestion** and **Absorption**

**Calorific value of carbohydrate, protein and fat:** 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 foods are used as sources of metabolic fuels. Carbohydrates, proteins and fats serve as the chief sources of energy in humans. These are oxidized and transformed into ATP, the chemical energy form used by cells to drive their multitudes of activities.

Since heat is the ultimate form of all energy, 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 $O_2$). 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 $1^0$C ($1.8^0$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<br><br>(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 diarrhea. |
| 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, diarrhea. |

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

# Chapter 19

## 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 insipedus*, a condition marked by the output of huge amounts 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.

# Chapter 20

# Locomotion and Movement

**Types of movements: Flagellar movement.**

Movement is most 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 sperm towards the ovum. This propulsion is brought about by the whip like movement of the tail and the middle piece of the sperm.

# Chapter 21

# Neural control and coordination

**Sense organs**

We humans are responsive organisms. Aroma of a freshly cooked dish makes our mouth water, loud thunder makes us jump in 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 many 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? Yes, 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: the 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 quantity 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 $cm^2$) of modified pseudo stratified epithelium called **olfactory epithelium**. It is located way up at the roof of the nasal cavity on either sides of the nasal septum.

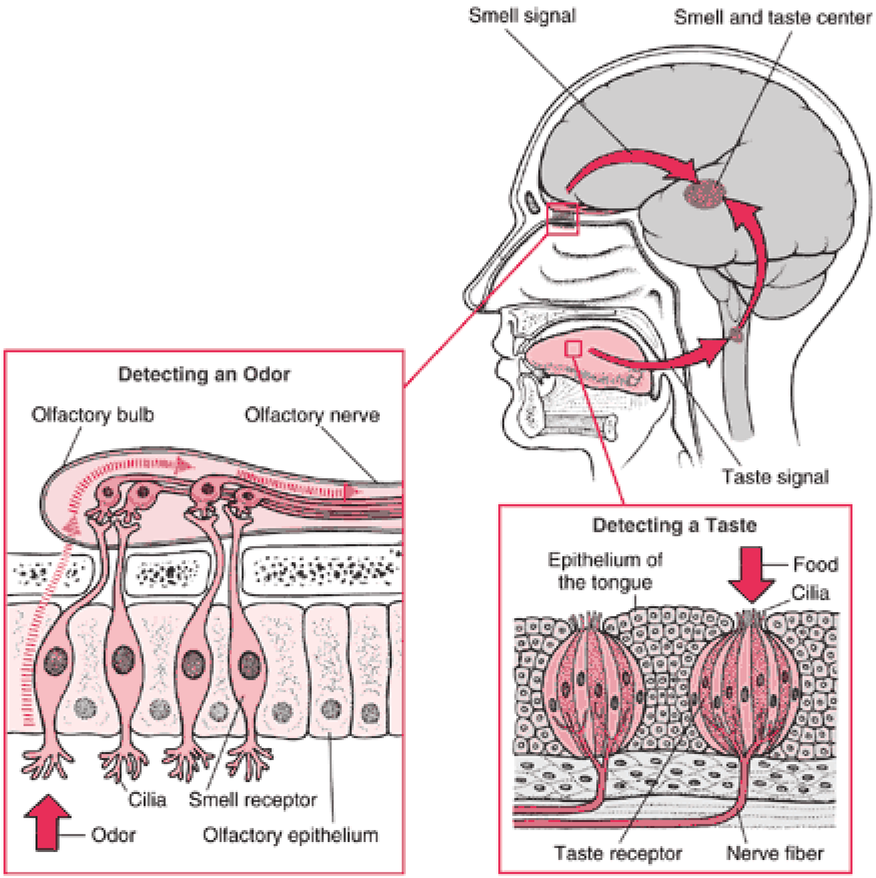


**Figure 1 Human nose showing olfactory bulb and magnified view of olfactory epithelium**

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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 taste, some of what we call smell, can be really painful. The nasal cavity contains pain receptors that respond to irritants such as ammonia, vinegar or hot chilly 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 vertebrates, especially fish and mammals such as a dog.

**Sense of taste (gustation)**

The sense of taste and smell work closely together. If we cannot smell some thing 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 more 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 rather specialized cells with slender microvilli on their outer ends. The microvilli protrude into the surrounding fluids through a narrow opening called the **taste pore**. Dissolved chemicals contacting the microvilli bind to specific receptor proteins on the microvilli, thereby depolarizing 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 mixture 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 are 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 light 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?

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, these transmit the sensation to the brain. Given below is a list of 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, net work of free nerve endings that surround hair follicles, are light touch receptors that detect bending of hairs. These report on wind blowing through your hair.

Meissner's corpuscles are small receptors in which a few spiraling dendrites are surrounded by specialized capsule (Schawann) 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 a caress or 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 firs 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 is 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.

# Chapter 22

## Chemical coordination and integration

**Exophthalmic goitre, 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 diffuse enlargement of the thyroid glands. 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 glands 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.

## Addison's' 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 mineralocorticoids. This condition is known as Addison's disease. Persons with Addison's disease tend to loose weight, their blood glucose and sodium levels drop and potassium levels rise. Can you explain why? Severe dehydration is also common in them.