

16. Skin

Fundamentals of Biology

Skin, as the outer most covering and **the largest organ** of the body, is active and functions in numerous ways

Grooves on the skin of fingers and palms provide better grip.
Skin eliminates urea, salts and water s in the form of sweat to maintain body temperature.

(1) Protects the inner organs from (a) ultraviolet rays of sunlight, (b) mechanical shocks, (c) excess loss of water (d) prevents the entry of harmful substances or disease causing germs.

Stores Food Reserve in form of a layer of fat contained in its cells. It synthesises Vitamin D from sunlight.

Regulates body temperature by preventing loss of body heat during winter, and facilitates loss of heat during summer.

Is the organ for sensation of Touch, and medium for external pain, pressure, heat. Constitutes 15% of total body weight, and is an impermeable barrier.

Structure of the Skin

Skin

Epidermis :

outer thin layer of skin made of Epithelium tissues , has an outer cornified layer , middle granular layer and inner malpighian layer .

Dermis:

inner thick layer of connective tissues made of elastic fibres. It also has fat cells, blood vessels, nerves, hair follicles , sebaceous glands

a) Cornified layer is made horny protein called keratin . Its cells are continually worn away and replaced by cells from the deeper malpighian layer. It is tough and resists bacterial infection , any damage, and loss of water by evaporation.

c) Malpighian layer is also called the germinative layer, and is the innermost layer of epidermis. The colouration of the skin is due to pigment melanin contained in the cells of malpighian layer

(4) Sweat gland is a simple coiled tube with a deeper secretory part , and an excretory part that runs upwards to the sweat pore on the epidermis. There are about two Million sweat pores in a human body. **Invisible sweating is a ongoing process.** In summers a person may lose up to 1 kg per hour as sweat. Sweat is 99 % water , 0.2 to 0.5 %salt, mainly sodium chloride, and traces of urea about 0.08 % . Urea lost through sweat if 1% of total urea lost by the body. In 'cold sweating' due to fright and nervousness, sweating may be accompanied by nausea and severe pain due to loss of body salts.

2) **Nails:** are hardened keratinous plate like structures, that grow as dead cells from the nail root. Matrix is the whitish half moon part of the nail that produces new cells , and pushes the old cells towards the front.

Derivative of the skin: Hair, Nails, sebaceous glands /sweat glands , and specialised function of mammary glands .

1) Hair : lies obliquely on the skin, and has a Hair Root embedded in the epidermis. The Hair bulb is a projection of the dermis called hair papilla, with a capillary blood supply . Hair follicle is composed of an epithelial and a connective tissue sheath.

- As nerve fibres extend to the base of the root hair, they provide a sensation of touch. Hairs of eyebrows ,eyelashes, nose hair protect the eyes and prevent dust particles from entering the body , through the nose. Beard hair are sexual dimorphism.

Its adipose tissue contain numerous fat cells that store subcutaneous fats. This fat serves as a heat insulating layer, and a shock absorber.

3) Sebaceous glands located on either side of the hair, has an opening along the hair. It gives out an oily secretion called 'Sebum' , that makes the skin oily and water proof. In winters, the sebaceous glands reduce the secretion of sebum, due to which the skin becomes dry. Pimples, acne, and black heads are the three problems associated to sebaceous glands.

b) Granular layer is a very thin middle layer of flattened cells . It gives way to the outmost cornified layer to replace the worn out cells

Modifications of Sebaceous and Sweat glands

1) Modified Sweat glands called mammary glands are present in males in a rudimentary state, but in females they enlarge to form a pair of breasts.

- Each has a central conical projection called nipple. About 15 to 20 milk ducts open into the nipple . Inwards, the ducts join a cluster of 15 to 20 lobes of mammary glands.
- The glands produce a reproductive hormone during pregnancy, which is called prolactin. The milk produced by the glands is highly nutritious for the new born baby.

2) Modified sebaceous glands, called Meibomian glands, exist in the eyes with openings on the margins of the eyelids. Their secretion is oily and serves to lubricate the margins of the lids and prevent the overflow of tears.

- Modified sebaceous glands called Ceruminous glands, secrete a wax like substance called cerumen or earwax. This lubricates the inner ear and protects the delicate eardrum from dust particles and germs.

Heat Regulatory function of the Skin

Heat regulation centre is in the forehead in the hypothalamus. It switches on or off the heat producing and heat reducing processes in the body. In winters, loss of heat through the skin is reduced by vasoconstriction or narrowing of the blood vessels. In hot weather, the blood vessels are dilated, and loss of heat through vasodilation is increased

All mammals and birds are warm blooded or endo-thermal, and generate heat from inside their body. This enables them to maintain their body temperature irrespective of heat or cold . Others are ecto-thermal

(a) 85% of Heat loss occurs through the skin due to evaporation of sweat by conduction, convection and radiation . (b) Lungs exhale warm breath (c) Urine and faece. (d) Intake of cold food, water and cold beverages

Heat is produced in the body through (a) chemical reactions in cells, and in liver in particular (b) due to muscular activities, that may overheat the body during summers (c) from ingestion of hot foods and beverages.

Human body temperature is 37 degree C in the mouth below the tongue. In the armpit it is 1 degree less, and is 1 degree more in the anus. In 24 hours this temperature may show variation from 0.3 C to 0.5C . It is lowest in the morning and highest at noon. Optimum temperature range between 35 degree C to 40 degree C is essential for enzymes and body activities. Higher temperature destroys enzymes while lower temperature slows their functioning.

Chapter 17. Respiratory System

(1) Energy is needed by the body to synthesise proteins from amino acids, produce enzymes, movement of muscles, conduction of electrical charge by nerve cells, production of new cells and for keeping the body warm.

Animals need more energy than plants as they move to obtain food, escape from predators, chew their food, look after their eggs and young ones.

Birds and mammals need more energy than animals or plants.

(2) This Energy is obtained through the process of respiration.

Respiration is a sub-conscious, chemical process of breaking down glucose for releasing energy, for use by the body for various activities.

Energy used in all cellular activities is obtained from oxidation of glucose during respiration. Glucose is obtained from carbohydrates.

Aerobic respiration and Anaerobic respiration are the two kinds of respirations. See chart 17.1 on page 146.

(3) The chemical reaction during respiration has five stages: (a) the process of yielding energy occurs within the cell and is called cellular or tissue respiration. (b) Breakdown of glucose to carbon dioxide and water occurs in the cytoplasm and the mitochondria, in a series of steps. (c) The steps are due to particular enzymes. (d) The energy released is partly in the form of heat, but largely converted to a chemical substance called adenosine triphosphate (ATP). One mole of glucose yields 38 molecules of ATP. (e) The respiration steps are the same in plants and animals.

(4) Parts of Respiration: (a) Breathing (b) Gaseous transport when oxygen absorbed by the blood is carried by the RBCs, as oxy-haemo-globin, throughout the body. The CO₂ from tissues is transported to the lungs by the veins in two ways: as bicarbonates dissolved in plasma, and the combination of haemoglobin and in combination with haemoglobin of RBCs as carbamino-haemoglobin. (c) Tissue respiration: the capillaries deliver the oxygen to the cells and capillaries and absorb carbon dioxide in exchange from them. (d) Cellular respiration: is the complex chemical changes that occur inside the cell to release energy from glucose.

(5) Respiratory organs include (a) Nose that has two nostrils, hair to prevent large dust particles from entering, a nasal chamber, which warms the inhaled air, adds moisture to it, and its mucous entraps harmful particles. It also is the organ for the sense of Smell.

Respiratory organs

continued

(b) Pharynx: is behind the nasal chamber and is the common passage for food from the mouth and air from and to the nose. From here, the food is directed in to the Oesophagus and air is directed into the Trachea

The Lungs: are a pair of spongy and elastic organs formed by air sacs, their connecting bronchioles, blood vessels. They are cone shaped, tapering on top and broader at the lower half. The right lung has three lobes while the left lung with two lobes is slightly smaller to leave space for the heart placed outside, towards the left side.

Lungs are covered by two membranes (a) the inner visceral pleura and the outer parietal pleura. The outer layer has a watery fluid called pleural fluid in the pleural cavity between the two membranes. This pleural fluid in the pleural cavity, provides lubrication for free movement of the lungs while expanding and contracting during breathing.

(c) Larynx: is the voice box. It is a hollow structure of cartilages at the top of the Trachea. It rises and falls during swallowing. It has two folds of vocal cords, that vibrate to produce sound.

(e) After emerging from the Trachea, each of the two Bronchus, inside the lung, branch out into finer and finer secondary branches, till the end tertiary branches are as fine as hair on the human head. These tertiary branches are called Bronchi. At the end of each is an air sac like structure called Alveolus. All the alveoli together provide a very large surface for exchange of oxygen and CO₂.

There is a protective inner layer made up of ciliated epithelium, that lines the entire respiratory passage. The cilia is constantly in motion and drives away any mucus that is trying to settle in the respiratory system, towards the mouth.

(d) Trachea is below the larynx, partly covered by the thyroid gland. Its walls have C-shaped rings of cartilage, that provide it flexibility. It is parallel to the oesophagus and behind it. On reaching the lungs, the trachea divides into two branches called the Bronchi, leading into the two lungs.

Blood Supply to the lungs.

from all parts of the body, into the Pulmonary Artery, that branches to take this blood to the two lungs. In the lungs the de-oxygenated blood reaches the air sacs or alveoli, through the capillaries, where oxygen from the inhaled breath is absorbed, and carbon dioxide is given up. The oxygen loaded blood is taken by the veins arising from the air sacs, and transported to the two Pulmonary Veins emerging out of the left and the right lungs to become a single Pulmonary Vein going towards the Left auricle of the heart. This oxygenated blood is poured by the Pulmonary Vein for circulation

2) Respiration is the overall process that includes the intake of air through breathing and the exchange of oxygen and CO₂ in the alveoli, and utilization of the body cells to produce energy from glucose.

(3) Breathing is the involuntary process of inhaling and exhaling of air.

- Diaphragm is a dome shaped, sheet of muscular tissue, that normally remains arched towards the base of the lungs. On contraction, it flattens out to allow the lungs to expand and the chest cavity to enlarge, lengthwise.

4) Respiration Cycle : (a) Inspiration or inhalation : results from increase in the size of thoracic cavity due to the combined action of the lungs and the diaphragm. The diaphragm pushes the ribs upwards to stretch the inter costal muscles between them. In addition, the pleural fluid between the pleura cavity layers, increases the space within the lungs, allowing the alveoli to expand on filling of air from the inhaled breath.

(b) Expiration or exhalation: is the result from the reverse movement of the ribs and the diaphragm. When the external inter costal muscles relax the ribs get depressed, and the cavity of the thorax diminishes, causing the lungs to compress and thereby force out the exhaled breath.

- See table on page 151 and 152