Ratna Sagar

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Education, Our Mission

As per the latest ICSE syllabus

Rama Sagar
Education, Our Mission!

Revised and Updated

LIVING SCIENCE BIOLOGY

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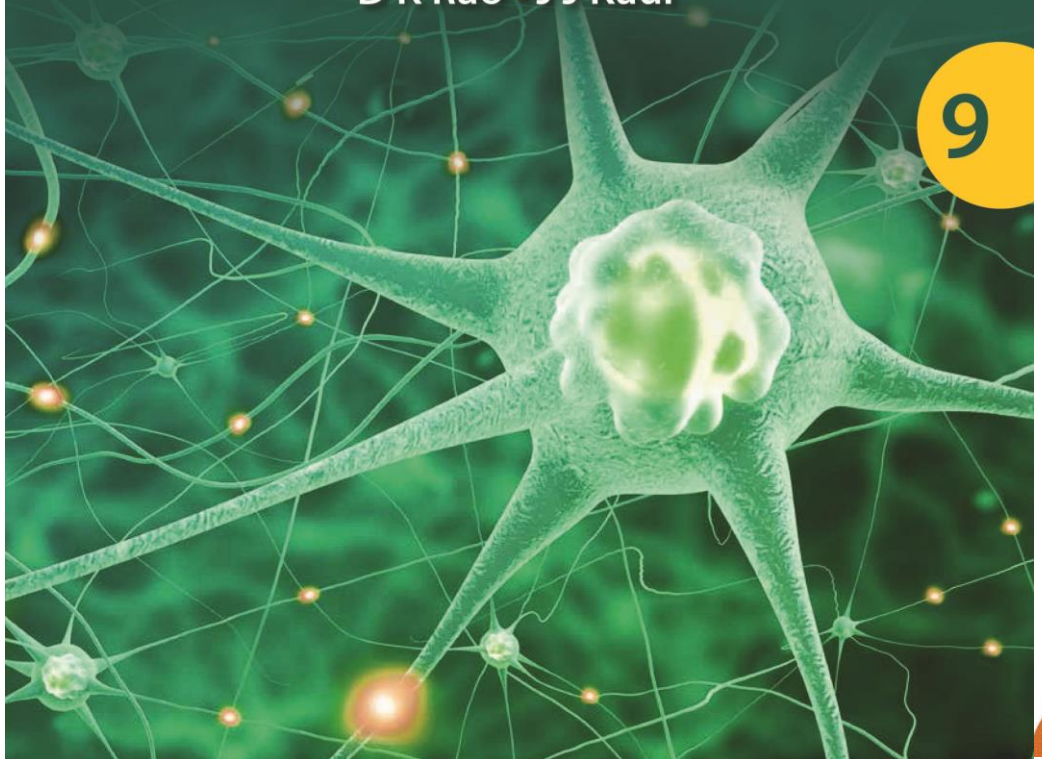

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ICSE
Living Science
Biology

Class 9

Chapter 13 Skin – Structure and Functions

LEARNING OBJECTIVES

Structure of the skin

The skin proper

- Epidermis
- Dermis – the living layer

Derivatives of the skin

- Hair, Nails, Sweat glands
- Mammary glands
- Sebaceous glands

Role of skin in the regulation of temperature of the body

- Response to cold weather
- Response to hot weather

Functions of the skin

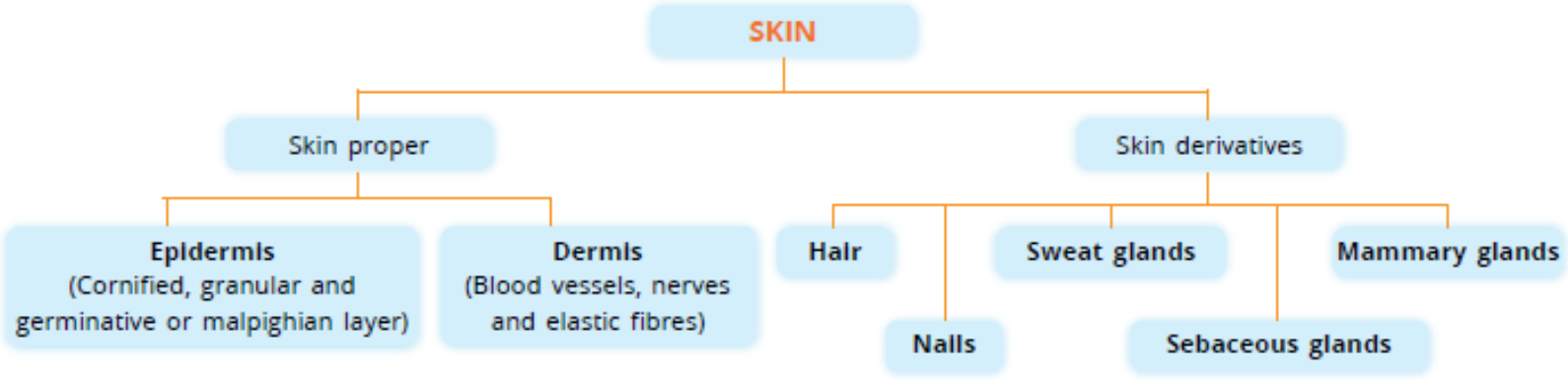
- Protection, Regulation of body temperature
- Cutaneous sensation
- Synthesis of vitamin D
- Storage organ, Excretion
- Organ of secretion
- Helps in gripping

What makes skin the largest organ in the human body?

Skin is the outermost covering of the body. It covers the entire body, has a surface area of 1.5 to 2 square metres, and accounts for about 15–16% of the total body weight in an average adult human being. This makes skin the **largest organ** in the human body.

Structure of the skin

The skin has mainly two components – the skin proper and the derivatives of the skin.



The skin proper

The skin is composed of two layers, the outer lifeless layer, **epidermis** and the inner living layer, **dermis**.

Epidermis

The epidermis is the outermost layer of the skin that meets the eye of the beholder. It is formed of **stratified epithelium** which are arranged in horizontal layers. The epidermis is a **lifeless tissue**. It does not contain blood vessels. Thus, epidermis is tough, physical and protective layer of the skin.

Epidermis has three sub-layers. They are

1. outermost cornified layer,

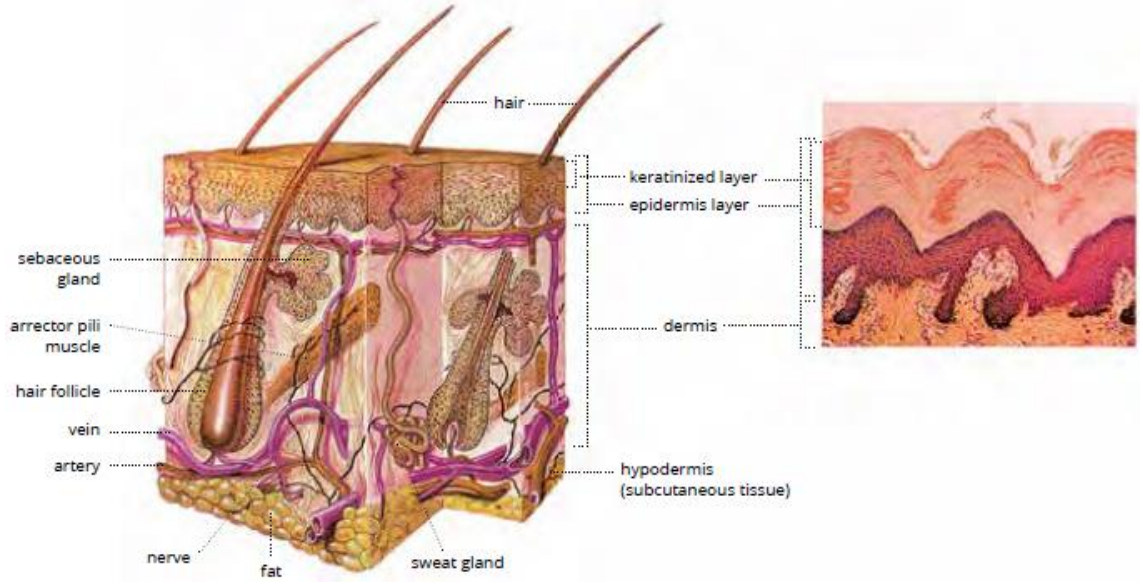
2. middle granular layer, and

3. innermost malpighian or germinative layer.

Cornified layer (Stratum corneum)

It is the outermost or topmost layer of the epidermis. It is made up of **flattened dead cells** which have lost their nuclei. These cells are arranged in superimposed piled up layers and then filled up with **keratin**. Keratin is a protein which forms the chemical basis of the skin tissues such as hair, feathers, nails, horns, hoofs and silk. It covers the entire body except the skin covering the mucous membrane. The tough cornified layer protects the deeper cells from **mechanical damage**, **bacterial infection** and **drying out** due to loss of water by evaporation.

The cornified layer is constantly worn away and replaced with new cells by peeling off in flakes or scales. This process is called **exfoliation**.

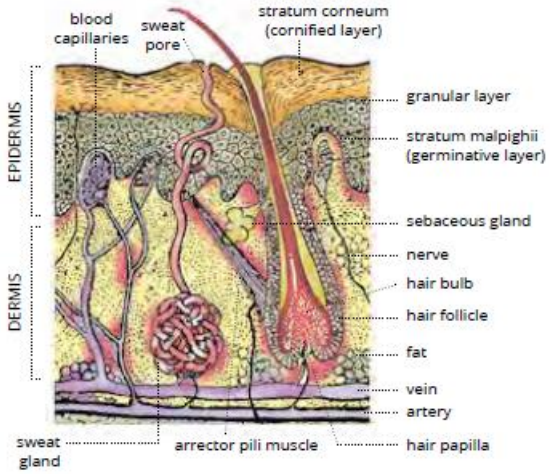


Granular layer (Stratum granulosum)

It is a very thin layer consisting of three to five sub-layers of flattened cells. **This layer consists of waterproof glycolipids** which slow down water loss across the epidermis. Gradually this layer hardens up to give way to the outermost cornified layer.

Germinative or malpighian layer (Stratum malpighii)

It is the innermost layer of the epidermis. Its cells actively divide to produce new cells which shift outwards to replace the worn out cells of the outermost cornified layer. This is the deepest epidermal layer firmly attached to the underlying dermis.



This layer also contains **melanin**, which provides colouration to the skin and absorbs the harmful ultraviolet rays, thus, protecting us. Prolonged exposure to sun causes a substantial build up of melanin, which helps protect DNA of skin cells from UV radiation.

Dermis – the living layer

The dermis (also called **corium**), is the inner thick layer of connective tissue made up of elastic fibres. The dermis is the **living layer** of the skin where most of the functions of the skin take place.

Dermis is rich in blood vessels which nourishes all the cells in it. Blood vessels in dermis also play a role in regulating body temperature. Dermis also contains nerve fibres, sensory organs, hair follicles, sweat glands, etc. The dermis has two major layers, the papillary and reticular layers.

The **papillary layer** is thin, superficial and made up of connective tissues which contain many blood capillaries. Its superior surface is raised into many small projections called **dermal papillae**. These dermal papillae **contain nerve endings which are sensitive to touch**, **pain** and **temperature**, making the skin a sensory organ.
The deeper **reticular layer** is concerned with the varying thickness of the skin. It is attached to the bone and muscles by the subcutaneous layer. The dermis also has specialized cells called **fibroblasts** which help in the production of collagen and elastin fibres. Elastin fibres provide elasticity to the skin.

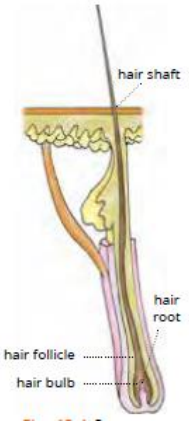
Derivatives of the skin

Along with the skin proper, the integumentary system includes several derivatives of the skin. These are:

1. Hair **2.** Nails **3.** Sweat glands **4.** Mammary glands **5.** Sebaceous (oil) glands

Hair

Hair are the epidermal outgrowths of the malpighian layer. These are also known as **pili**. Hair are flexible strands produced by hair follicles consisting mainly of the hard keratin. The chief regions of the hair are hair shaft, hair root and hair bulb.



❖ **Hair shaft** is the part which projects from the skin . The shape of the shaft determines whether hair is straight or curly.

❖ The **hair root** is the part embedded in the skin within epidermis.

❖ The lowest part of the hair root enlarges into a soft structure called **hair bulb**. The hair bulb is the only living tissue of the hair. Hair bulb is formed in **hair follicle**. A hair papilla containing the blood capillaries enters.

Hair colour

The hair contains melanin. The colour of hair is due to melanin. The grey or silvery hair colour is due to minute air spaces formed in the hair when melanin pigment is lost.

Functions of hair

❖ Hair provide warmth by trapping an insulating layer of air beneath them as in most mammals with fur on their body.

❖ Hair from different parts of the body such as head, chest, beard, etc., show marked differences. This helps in crime detection.
❖ Facial hair in humans help in sexual dimorphism (i.e. in distinguishing the male sex from female).
❖ Hair along the edges of the eyelids (eyelashes) help in preventing the entry of foreign particles into the eyes.
❖ Hair in the nostrils (nose) prevent dust particles from entering the nasal passages, thus helping in cleaner breathing.

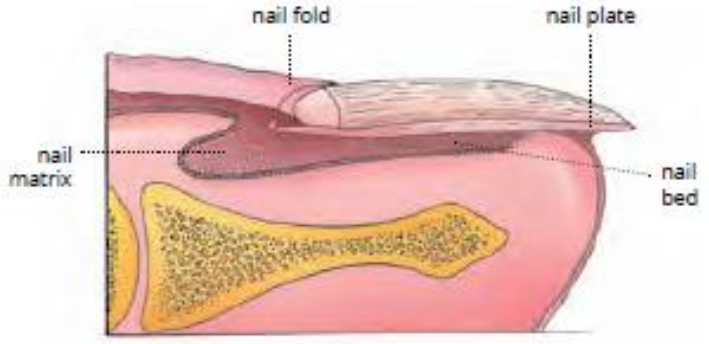
Nails

A nail is a hardened keratinous plate-like modification of the epidermis that forms a clear protective covering on the dorsal surface of the finger or toe. Nails grow as dead cells from the nail root, which lie below the skin at the base come outward. Nail has three main parts:

❖ **Nail plate:** It is the hard outer part of the nail made up of dead keratinized cells.

❖ **Nail bed (nail root):** It lies below the plate. Both bed and plate originate from the nail matrix.

❖ **Nail matrix:** It lies below the skin surface at the base of the nail.



Sweat glands

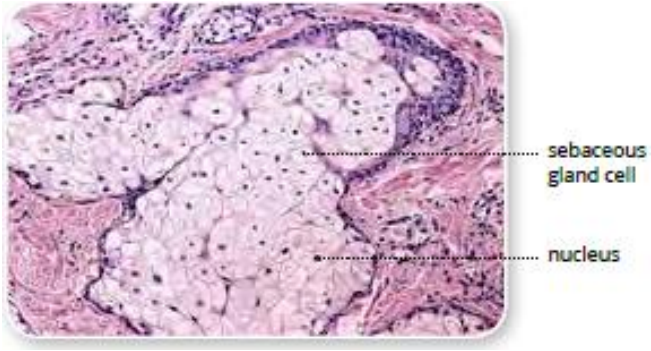
Each sweat gland is a simple, coiled, tubular gland. Its secretory part lies coiled in the dermis. The duct extends to open in a funnel-shaped pore at the surface of the skin. Sweat glands, also called **sudoriferous glands**, are distributed over the entire skin surface except the nipples and parts of external genitalia.

Mammary glands

Mammary glands are a variety of specialized sweat glands which secrete milk. They are also part of integumentary system. The mammary glands are present in both sexes, but they are normally functional only in females. Their main function is to produce milk to nourish a newborn baby. Each mammary gland is contained within breast. Slightly below the centre of each breast is a ring of pigmented skin called **areola** which surrounds nipple.

Sebaceous glands

Sebaceous or oil glands are simple glands found all over the body except on the palms and soles.
Their size varies, smaller on the trunk and limbs but quite large on the face, neck and upper chest region.
These glands open into hair follicles. These glands secrete an oily secretion called **sebum.**



Role of skin in the regulation of temperature of the body

There are two types of animals depending upon the body temperature – **cold-blooded**, meaning animals whose body temperature fluctuates according to the temperature of the environment (like fishes, reptiles, etc.) and **warm-blooded**, meaning animals whose body is maintained at a constant temperature (like mammals and birds).

Ectotherms are organisms that obtain heat from external sources. Reptiles and frogs are ectotherms. On the other hand, animals who maintain more or less constant body temperature by generating their body heat metabolically are called **endotherms**. Humans, other mammals and birds are endotherms.

Response to cold weather

As soon as hypothalamus in the brain detects a drop in the blood temperature due to colder environment, four types of responses occur:

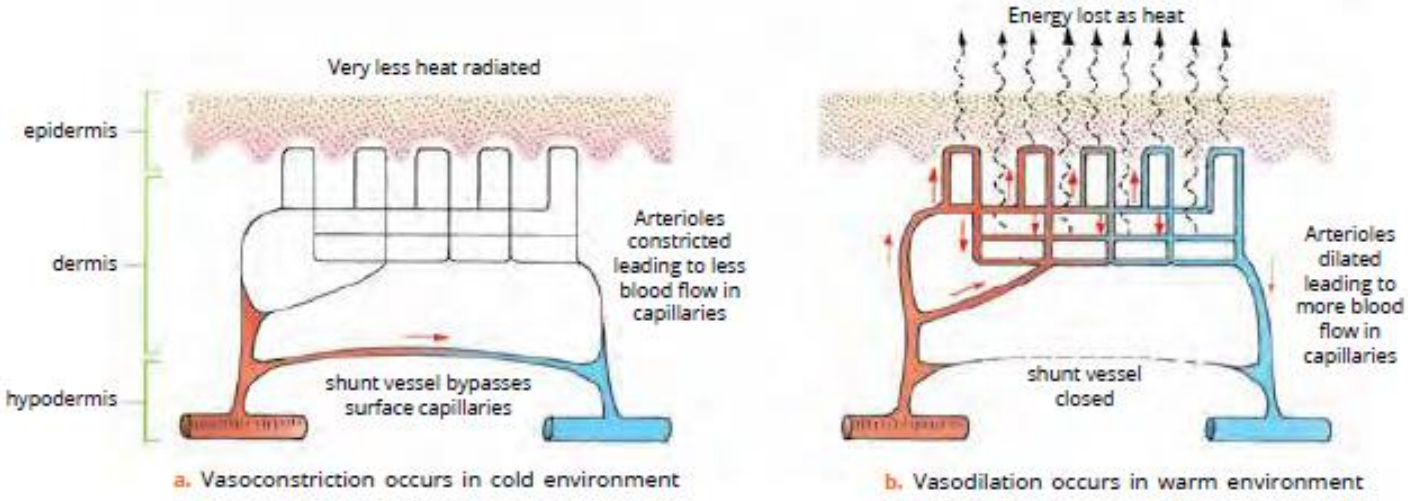
❖ We start to shiver due to **rapid contraction and relaxation of muscles**. Shivering muscles **provide heat**.

❖ **Vasoconstriction:** The arterioles leading to the blood capillaries in the surface layers of skin narrow down reducing the flow of blood to skin. This cuts down the amount of heat lost through the skin. Vasoconstriction is controlled by sympathetic nerves passing from brain.

Response to hot weather

❖ **Vasodilation:** Arterioles leading to skin capillaries dilate and shunt vessels are closed leading to increased blood flow to the skin . As a result, more heat is lost to the environment. Along with sweating, vasodilation is an efficient cooling mechanism.

❖ **Sweating:** In hot temperature, excessive sweating occurs. Evaporation of sweat from the skin's surface cools down the body.



Functions of the skin

The skin is suitably called the '**jack of all trades**' because it performs many important functions.

Protection

Skin is a very effective protective organ.

❖ It protects the underlying organs against mechanical injuries from pressure, friction and blows.

❖ It **prevents excessive loss of water** due to evaporation by holding the body fluids inside.

❖ It acts as **chemical barrier**. Its secretions such as sebum kill the microorganisms like bacteria.

❖ Integumentary derivatives such as hair and cushions of fat help in minimizing the effects of external pressure and injuries.

❖ It contains melanin that **protects the body against ultraviolet radiation** which are very harmful.

Regulation of body temperature

Body works best when temperature is under normal limits. The skin prevents loss of heat during cold weather (vasoconstriction) and helps in loss of heat in hot weather (vasodilation).

Cutaneous sensation

The skin is richly supplied with cutaneous sensory receptors. These receptors help in sensing touch, pain, pressure, heat, etc.

Synthesis of vitamin D

Skin helps in the synthesis of vitamin D. When sunlight falls on the skin, cholesterol molecules in the epidermal cells of skin are converted into vitamin D precursor. This precursor is absorbed in dermal capillaries and transported to other parts of the body.

Storage organ

Skin stores excessive subcutaneous fat which can be used in times of need.

Excretion

Skin helps in excretion of nitrogenous wastes (ammonia, urea and uric acid), water and salts.

Organ of secretion

Mammary glands which are specialized sweat glands, secrete milk and nourish young ones.

Helps in gripping

Skin on our fingers, palms and soles forms grooves and ridges which help in efficient grip.

SUMMARY...

❖ The skin is the outermost covering of the body. It is the largest organ.

❖ The skin is composed of two tissue layers, an outer epidermis and an inner deeper dermis.

❖ Epidermis has three sub-layers, outermost cornified layer, middle granular layer and the innermost germinative or malpighian layer. The cornified layer contains dead cells that are continuously discarded and replaced with new cells.

❖The dermis is composed mainly of dense, irregular connective tissue and is well-supplied with blood vessels, nerves and fibres. Cutaneous receptors, glands and hair follicles are also found in dermis.

❖ The colour of the skin is provided by the melanin pigment in it.

❖ There are many derivatives of skin such as hair, nails, sweat glands, mammary glands and sebaceous glands.

❖ The sweat glands are of two types – eccrine and apocrine. Eccrine sweat glands are distributed all over the body surface. Their primary function is thermoregulation. They secrete sweat. Apocrine glands are found primarily in axillary and genital region.

- Sebaceous glands occur all over the body surface except the palms and the soles. They are simple alveolar glands and secrete sebum.
- Sebum lubricates the skin and hair, prevents water loss from the skin and acts as a bactericidal agent.
- A hair is an epidermal derivative of skin. It contains a shaft, a root, a bulb and hair follicle.
- A nail is a plate-like modification of the epidermis that covers the dorsal surface of fingers.
- The skin performs many functions such as protection from mechanical injuries, body temperature regulation, sensation, metabolic functions, blood reservoir, stores food and performs excretion.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