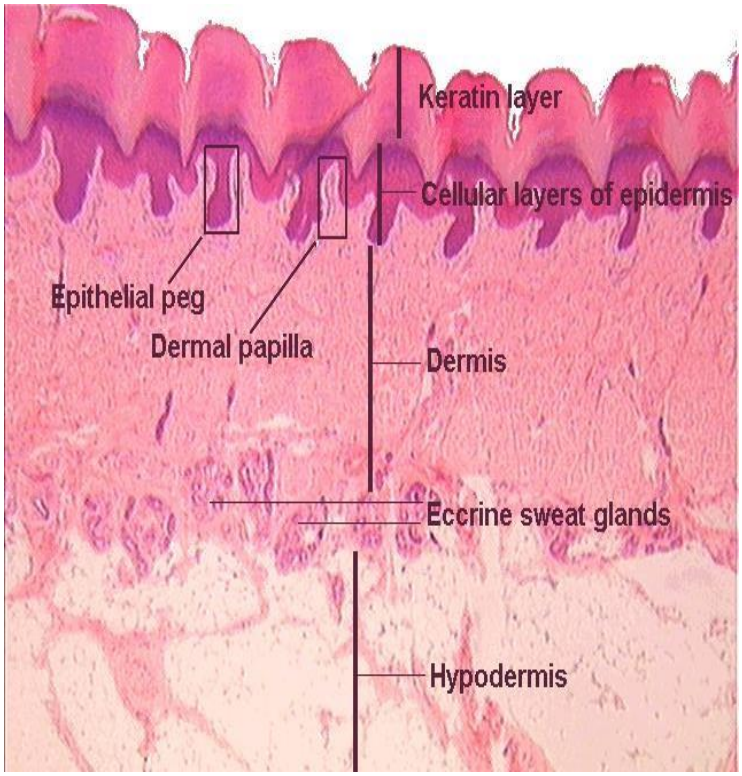
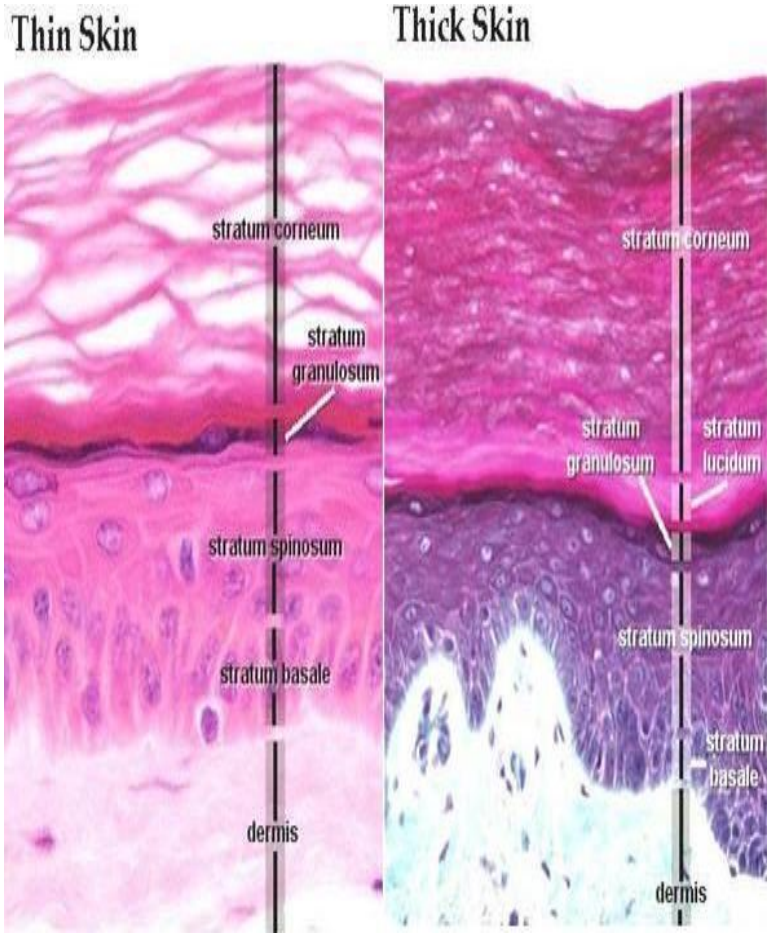
The Integumentary System

The integument, composed of skin and its appendages, sweat glands, sebaceous glands, hair and nails, is the largest organ, constituting l6% of the body weight.



Skin .It is composed of the epidermis, an epithelial layer of ectodermal origin, and the dermis, a layer of connective tissue of mesodermal origin. The junction of dermis and epidermis is irregular, and projections of the dermis called **papillae** interdigitate with evaginations of the epidermis known as **epidermal ridges**. Beneath the dermis lies the hypodermis, or subcutaneous tissue, a loose connective tissue that may contain a pad of adipose cells. The hypodermis, which is not considered part of the skin, binds skin loosely to the subjacent tissues.



Skin is classified as thick or thin according to the thickness of the epidermis and are distinguished by the presence or absence of certain epidermal layers and the presence or absence of hair.

Thick skin covers the palms and soles. The epidermis of thick is characterized by the presence of all five layers of cells. Thick skin lacks hair follicles, muscles, and sebaceous glands but does possess sweat glands.

Thin skin covers most of the remainder of the body. The epidermis has a thin stratum corneum and lacks a definite stratum lucidum and stratum granulosum, although individual cells of these layers are present in their proper locations.

Besides providing a cover for the underlying soft tissues, skin performs many additional functions, including

(1) protection against injury and bacterial invasion; (2) regulation of body temperature (3) reception of continual sensations from the environment (e.g., touch, temperature, and pain); (4) excretion from sweat glands; and (5) absorption of ultraviolet (UV) radiation from the sun for the synthesis of vitamin D.

Skin is composed of three layers which are:

1- Epidermis

The epidermis is covered by stratified squamous keratinized epithelium and contain four populations of cells: keratinocytes, melanocytes, Langerhans cells, and Merkel's cells.

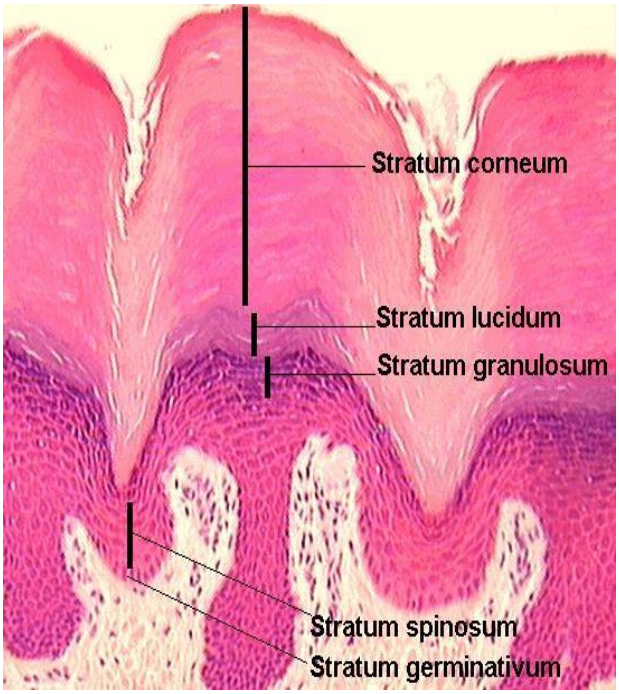
A-Keratinocytes (epithelial cells)

Form the largest population of cells, are renewed through mitotic activity in the basal layers of the epidermis; as the new cells are forming, the cells above continue to be pushed toward the surface, as they near the surface, the cells die and are sloughed off, a process that takes 20 to 30 days.

Five morphologically distinct zones of the epidermis can be identified. From the inner to the outer layer, these are:

(1) **Stratum basale (germinativum)**: consists of a single layer of basophilic columnar or cuboidal cells resting on the basement membrane at the dermal- epidermal junction. The stratum basale, containing stem cells, is characterized by intense mitotic activity and is responsible, in conjunction with the initial portion of the next layer, for constant renewal of epidermal cells.

(2) **Stratum spinosum**: consists of cuboidal, or slightly flattened, cells with a central nucleus and a cytoplasm whose processes are filled with bundles of keratin filaments called tonofilaments play an important role in maintaining cohesion among cells and resisting the effects of abrasion. A11 mitoses are confined to what is termed malpighian layer, which consists of both the stratum basale and the stratum spinosum. Only the malpighian layer contains epidermal stem cells.

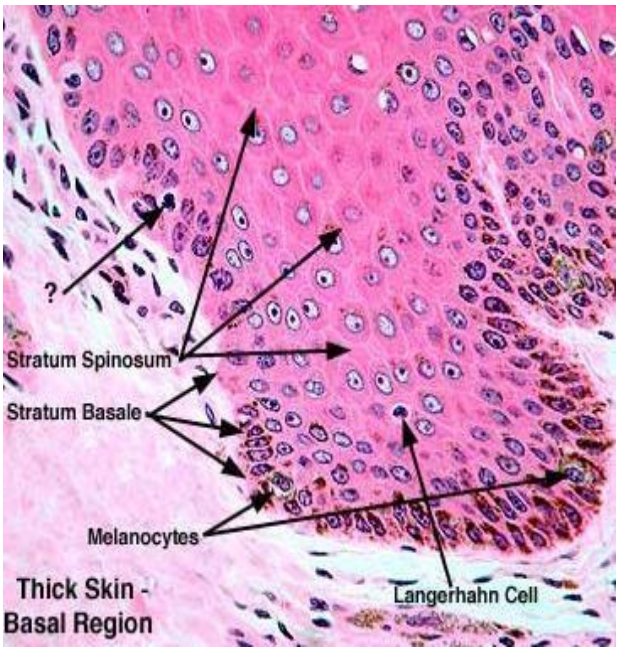


(3) **Stratum granulosum**: consists of 3-5 layers of flattened polygonal cells whose cytoplasm is filled with coarse basophilic granules called keratohyalin granules. The function of this extruded material is similar to that of intercellular cement in that it acts as a barrier to penetration by foreign materials and provides a very important sealing effect in the skin.

(4) **Stratum lucidum**: More apparent in thick skin, the stratum lucidum is a translucent, thin layer of extremely flattened eosinophilic epidermal cells. The organelles and nuclei are no longer evident.

(5) **Stratum corneum**: consists of 15-20 layers of flattened non-nucleated keratinized cells with a thickened plasma lemma and filled with keratin filaments embedded in an amorphous matrix. Those cells farther away from the skin surface display desmosomes, whereas cells near the surface of the skin called squamous or horny cells, lose their desmosomes and become desquamated (sloughed off).

B-Nonkeratinocytes

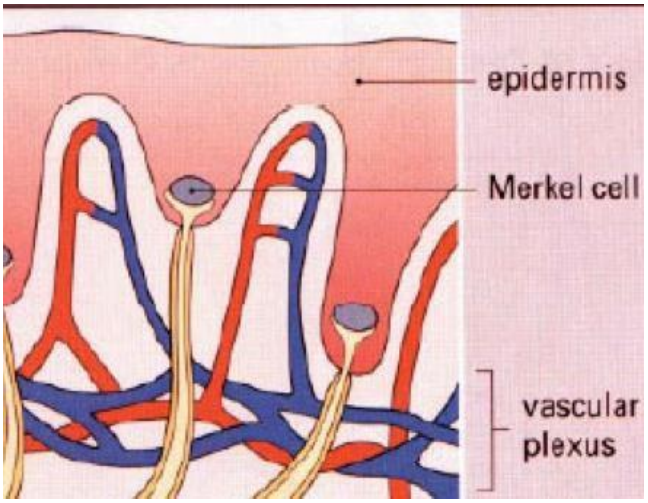


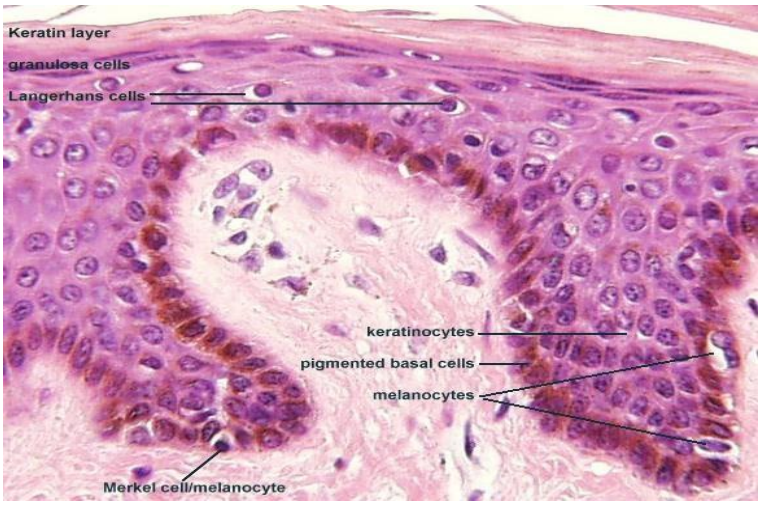
(1) **Melanocytes**: are round to columnar Cells located among the cells of the stratum basale; their long, undulating processes extend from the superficial surfaces of the cells and penetrate the intercellular spaces of the stratum spinosum and are responsible for the production and secretion of melanin. The difference in skin pigmentation is related more to location of the melanin than to the total number of melanocytes in the skin. Single exposure to ultraviolet radiation increases the size and functional activity of the melanocytes, their population remains the same. After continued exposure to ultraviolet radiation, however, there is also an increase in the melanocytes population.

(2) **Langerhans Cells**: star-shaped cells found mainly in the stratum spinosum of the epidermis, they have a significant role in immunologic skin reactions

(3) **Merkel's Cells**: generally present in the thick skin of palms and soles (scattered among cells of the stratum basale), somewhat

resemble the epidermal epithelial cells but have small dense granules in their cytoplasm. These cells may serve as

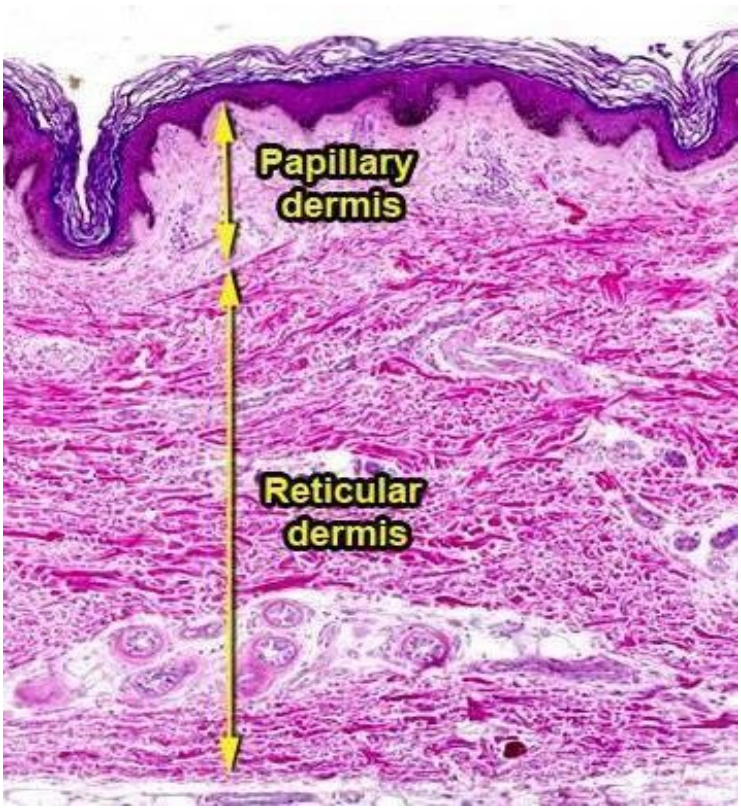




sensory mechanoreceptors.

2- Dermis (Corium)

The dermis is the connective tissue that supports the epidermis and binds it to the subcutaneous tissue (hypodermis). The thickness of the dermis varies according to the region of the body and reaches its maximum on the back. The surface of the dermis is very irregular and has many projections (dermal papillae) that interdigitate with projections (epidermal pegs or ridges) of the epidermis. The dermis has a rich network of blood which play a very important role in temperature regulation, and lymph vessels in addition to rich supply of nerves in the dermis.



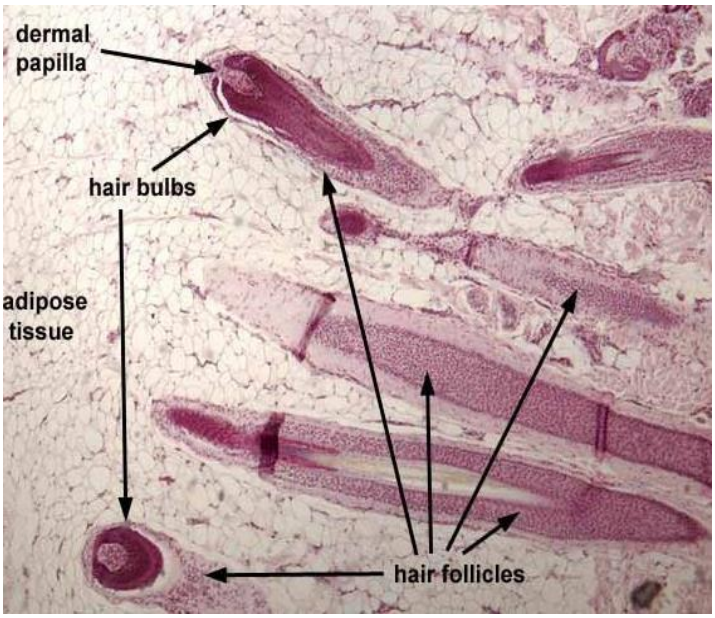
Normally, the dermis is thicker in men than in women and on the dorsal than on the

ventral surfaces of the body. **The dermis contains 2** layers with rather indistinct boundaries-the outermost papillary layer, and the deeper reticular layer.

(1) **The papillary layer**: is thin and composed of loose connective tissue; fibroblasts and other connective tissue cells, such as mast cells, macrophages, and plasma cells are present. Extravasated leukocytes are also seen.

(2) **The reticular layer:** is thicker, composed of irregular dense connective tissue (mainly type I collagen), and therefore has more fibers and fewer cells than does the papillary layer.

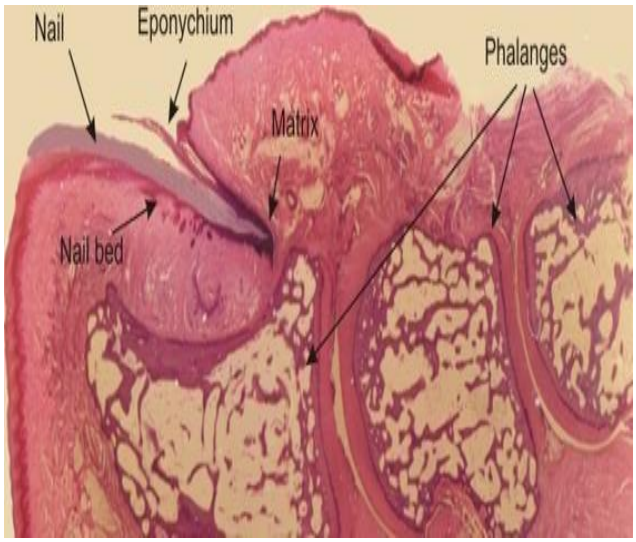
In addition to these components, the dermis contains epidermal derivatives which are:



(1) Hairs:

Are elongated keratinized structures; each hair arises from an epidermal invagination called the hair follicle which has a terminal dilatation called a hair bulb. At the base of the hair bulb there is the dermal papilla. The papilla contains capillaries and is covered by cells that form the hair root and develop into the hair shaft. Loss of blood flow or loss of the vitality of the dermal papilla will result in death of the follicle.

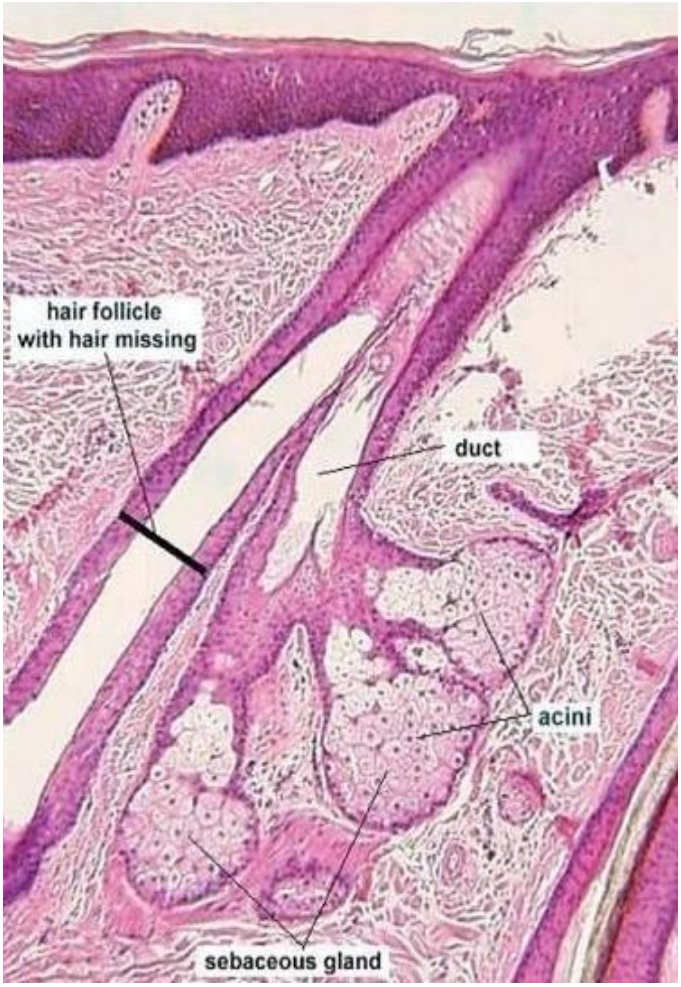
(2) Nails:



Represent keratinized epithelial cells arranged in plates of hard keratin; located on the distal phalanx of each finger and toe, are composed of plates of heavily compacted, highly keratinized epithelial cells that form the nail plate, lying on the epidermis, known as the nail bed.

(3) Glands:

A-Sebaceous Glands: are acinar glands embedded in the dermis over most of the body surface. but the frequency increases in the face, forehead, and scalp. They usually have several acini opening into a short duct which usually ends in the upper portion of a hair follicle; in certain regions, such as the lips, it opens directly onto the epidermal surface.



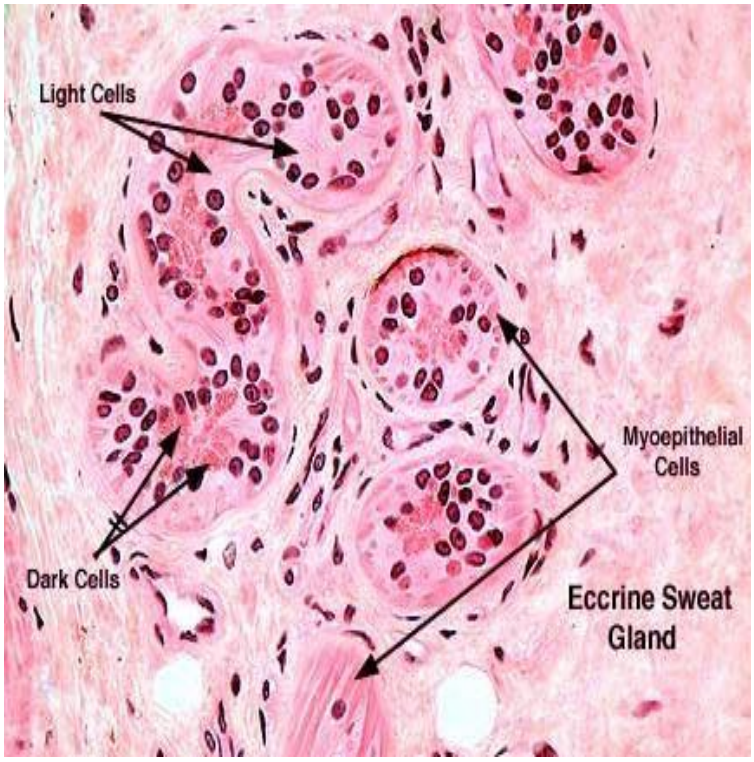
The acini consist of a basal layer of undifferentiated flattened epithelial cells that rest on the basal lamina. These cells proliferate and differentiate, filling the acini with rounded cells containing increasing amounts of fat droplets in their cytoplasm. Their nuclei gradually shrink, and the cells simultaneously become filled with fat droplets and burst. The product of this process is

sebum, the oily secretion of the sebaceous gland, which is gradually moved to the surface of the skin.

Sebaceous glands are holocrine gland begin to function at puberty. The primary controlling factor of sebaceous gland secretion in men is testosterone; in women it is a combination of ovarian and adrenal androgens.

B-Sweat Glands:

1: **Merocrine glands**. They are simple, coiled tubular glands whose ducts open at the skin surface. Their ducts do not divide, and their diameter is thinner than that of the secretory portion. The secretory part of the gland is embedded in the dermis is surrounded by myoepithelial cells. Contraction of these cells helps to discharge the secretion. Two types of cells have been described in the secretory portion of sweat glands:



(A) **Dark cells (mucoid cells)** are pyramidal cells that line most of the luminal surface of this portion of the gland. Their basal surface does not touch the basal lamina. Secretory granules containing glycoproteins are abundant in their apical cytoplasm, and the secretion released by dark cells is mucous in nature.

(B) **Clear cells** do not possess secretory granules; they are involved in transepithelial salt and fluid transport. Clear cells have limited access to the lumen of the gland because of the dark cells; therefore, their watery secretion enters intercellular canaliculi interposed between adjacent clear cells, where it mixes with the mucous secretion of the dark cells. The ducts of these glands are lined by stratified cuboidal epithelium.

2: **Apocrine sweat** glands: is present in the axillary, areolar, and anal regions. Apocrine glands are much larger than merocrine sweat glands. They are embedded in the dermis and hypodermis, and their ducts open into hair follicles. Apocrine glands are innervated by adrenergic nerve endings, whereas merocrine glands receive cholinergic fibers.

3- Subcutaneous Tissue (hypodermis)

Is a tissue layer consists of loose connective tissue that binds the skin loosely to the subjacent organs, making it possible for the skin to slide over them. The hypodermis often contains fat cells that vary in number according to the area of the body and vary in size according to nutritional state. This layer is also referred to as the superficial fascia of gross anatomy and.

The connective tissue of the skin contains a rich network of blood and lymphatic vessels. The arterial vessels that nourish the skin from 2 plexuses. One is located between the papillary and reticular layers; the

other, between the dermis and the subcutaneous tissue. Veins are disposed in 3 plexuses, 2 in the position described for arterial vessels and the third in the middle of the dermis, participating in the regulation of body temperature. Lymphatic vessels begin as closed sacs in the papillae of the dermis and converge to form 2 plexuses, as described for the arterial vessels.

SENSORY RECEPTORS

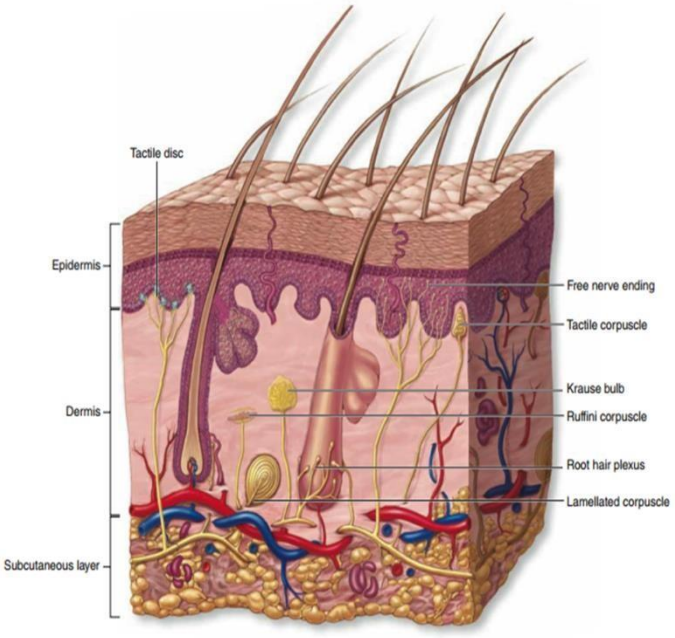
With its large surface and external location, the skin functions as an extensive receiver for various stimuli from the environment. Diverse sensory receptors are present in skin, including both simple nerve endings with no Schwann cell or collagenous coverings and more complex structures with sensory fibers enclosed by glia and delicate connective tissue capsules.

The encapsulated receptors include the following:

■ The Merkel cells, each associated with expanded nerve endings which function as tonic receptors for sustained light touch and for sensing an object's texture.

■ Free nerve endings in the papillary dermis and extending into lower epidermal layers, which respond primarily to high and low temperatures, pain, and itching, but also function as tactile receptors.

■ Root hair plexuses, a web of sensory fibers surrounding the bases of hair follicles in the reticular dermis that detects movements of the hairs.



The encapsulated receptors are all phasic mechanoreceptors, responding rapidly to stimuli on the skin. Four are recognized in human skin, although only the first two are seen in routine preparations: ■ Meissner corpuscle :consisting of sensory axons winding among flattened Schwann cells arranged perpendicular to the to the epidermis in the dermal papillae