

The Integumentary System

The objectives:

By: Lecturer Wafaa S. Dawood

- TO know the functions of this system
- To recognize the layers of skin the epidermis dermis and hypodermis
- TO know about skin color, sensation of skin and blood supply.
- TO know about the accessory structures(hair, nails and glands of skin.

The Integumentary System Includes : Skin and Skin derivatives (appendages) that are
Hair ,nail, sweat and sebaceous glands .

Functions of integument

Mechanical protection: The keratinized stratified epithelium of the skin provides mechanical protection against external abrasions and against invasion of bacteria and objects.

- **Thermoregulation.** The skin plays a major role in regulation of body temperature.
- **Osmoregulation,** The skin is important in the regulation of body fluids and ions, and also protects against fluid loss.
- **Excretion and secretion.** By exocrine glands (sweat glands, sebaceous glands).
- **Sensory reception.** Several different types of receptors present in the skin respond to a variety of stimuli such as touch, pressure, heat, cold, pain.
- **Metabolic functions & Absorption**
- **Skin**
- skin is the largest single organ of the body, It is about 15 to 20% of total body weight

Skin Is composed of 2 main layers:

- The epidermis; and the dermis while the hypodermis is a layer below the dermis_(the superficial fascia) that has variable amount of adipose cells.

The epidermis is ectodermal in origin but the dermis is mesodermal in origin.

Types of Skin: There are thin skin and thick skin refer to the thickness of the

Epidermal layers, which alone varies from 75 to 150 μm for thin skin and from 400 to 1400 μm (1.4 mm) for thick skin.

Epidermis:

The epidermis is composed of stratified squamous epithelium and is composed of 4 layers in thin skin but 5 in thick skin.

Cells of the epidermis:

4 cell types, with different embryologic origins, are distinguished in the epidermis:

1- Keratinocytes (keratin production)

2- Melanocytes (pigment production)

3- Langerhans cells (immune system)

4- Merkel cells (tactile sensation).

The most superficial cells of epidermis are dead cells, or scales, composed of keratin.

These superficial keratinized cells are continuously being lost (desquamation or exfoliation) and need to be replaced. New keratinocytes are continuously formed in the basal layers of the epithelium.

Epidermis of thick skin: It is 5 layers or strata from innermost to outermost:

1- Stratum basale:

Is a single layer of cuboidal to low columnar cells rest on the basement membrane, that attached by (hemi desmosomes)and the cells are attached to each other by (desmosomes).

This layer has stem cells from which keratinocytes arise.

The stratum basale is recognized by mitotic activity.

2- Stratum Spinosum (prickle cells):

Is the thickest layer, consists of several layers of polyhedral cells, having central nuclei with nucleoli. The cytoplasm have processes attached to the processes of other cells in this layer by desmosomes.

As they mature, they become flat and increased in size .

3- Stratum granulosum:

Is composed of (1-3) layers of flattened cells their cytoplasm contain irregular granules called keratohyaline..

- The size and number of these granules increased, while the nucleus become pale and degenerate.

4- Stratum lucidum :

Is translucent, clear, homogenous layer lightly stained.

The cells have no organelles, no nuclei, but contain keratin filaments

5- Stratum corneum :

Is composed of clear, scale-like cells, have protein of keratin filaments ,surrounded by lipids, which prevent loss of fluid through the skin that act as water proof.

Keratin gives this layer its structural strength.

Thickness of this strata is greatest where the skin is exposed to friction.

Keratinization is the conversion of granular cells into cornified cells. Keratin gives this layer its structural strength. Thickness of this strata is greatest where the skin is exposed to friction. The lamellar bodies are secreted and coated the cells with a glycolipid forming a water barrier. Here it is soft keratin .

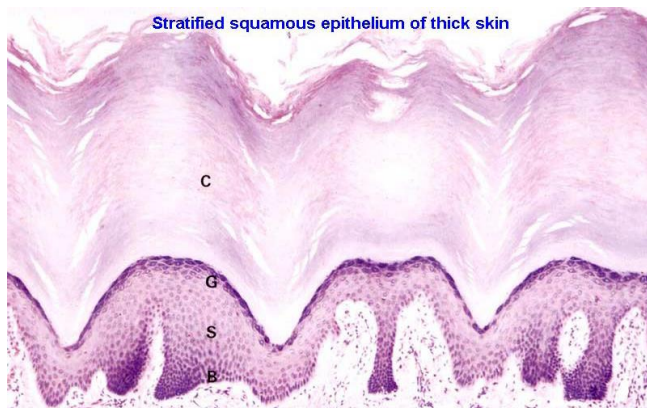
Keratinization is involved:

- 1-Breakdown of the nucleus.
- 2-The thickening of the plasma membrane.

Cytomorphosis is a process of differentiation of the basal cells into the desquamating superficial scales,

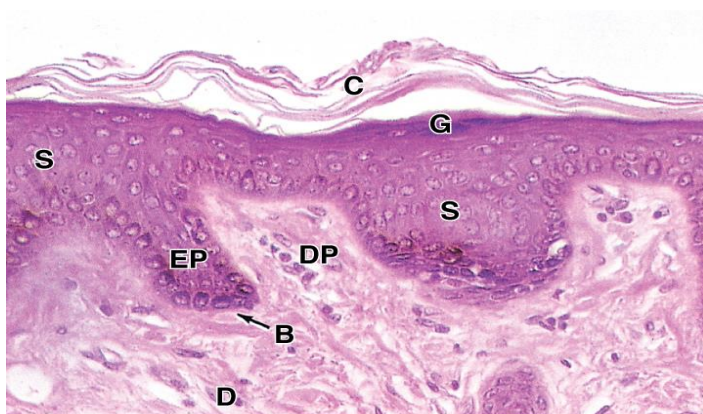
The human epidermis is renewed about every 15 to 30 days, depending on age, the region of the body, and other factors

The epidermal layer is therefore being totally replaced .The morphological changes occur in the keratinocytes and the layers are best seen in thick skin.



Epidermis of thin skin:

- 1-Reduce in thickness of the layers.
- 2-Absence of-stratum lucidum.



Melanocyte:

- Is found in stratum basale or in contact with basement membrane
- Developed from neural crest
- Pale-staining cells; oval nucleus, have cytoplasmic processes extend between the basale cells.
- The cytoplasm have organelles called melanosomes produce melanin pigments to give the color of skin.
- Reduce the damage of skin by ultra violet radiation.
- Their number differ in different area of the body, range about 800-2300/mm²
- **Langerhane cells:**
- Are fixed macrophages, dendritic cells or known as antigen-presenting cells.
- Located in stratum spinosum, may be found in the dermis.
- They are developed in bone marrow, have a role in immune response. These cells have cytoplasmic processes , oval nucleus, and few mitochondria.

Merkel cells:

- Are found in stratum spinosum, interspersed between keratinocytes
- They are disc-like structures
- Have irregular shaped nucleus.
- The cytoplasm contain granules.
- They are tactile receptors.
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Dermis :

The dermis is the fibrous connective tissue , supportive layer of the skin, two types of fibers are found: Collagen fibers and elastic fibers.

Collagen fibers ,have tensile strength that provide the skin strength and toughness. Collagen bundles are small in the upper part of dermis, and form thicker bundles in the deeper layer of dermis.

Elastic fibers : provide the properties of elasticity to the skin .

The collagen and elastic fibers are bound together by ground substance, a mucopolysaccharide gel in which the nutrients and wastes can diffuse to and from other tissue components.

Dermis is divided into 1- Papillary layer and 2- Reticular layer:

1- Papillary layer:

This layer is interdigitate with epidermis by projections , (dermal papillae); well developed in thick skin

- It is composed of loose connective tissue (collagen, elastic fiber) and few reticular fiber.
- In this area tactile receptors called Miessner's corpuscles are found.

2- Reticular layer:

- Is dense irregular connective tissue composed of collagen fiber type I run parallel to the skin surface. A network of elastic fiber, few collagen fiber type III, fibroblast, mast cells, lymphocytes, nerve ending receptors for pressure called Pacinian corpuscles are found.

Skin Colors (Pigmentation) depend on:

- Hemoglobin is red pigment of red blood cells
- Carotene is yellow pigment of vegetables & egg yolks
- Melanin pigment produced by melanocytes

Pigment synthesis stimulated by UV radiation from sunlight

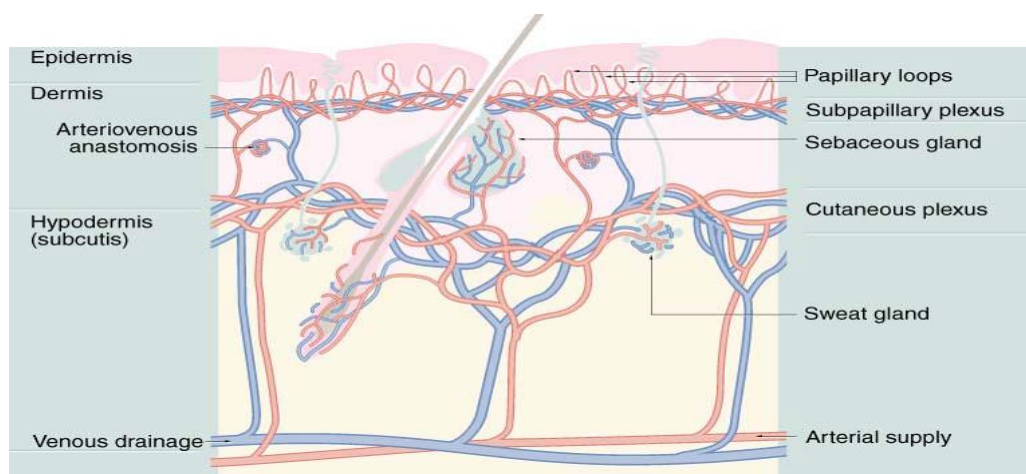
Blood supply of skin

Epidermis is avascular area ,the nourishment reach it by diffusion.

The blood vessels are located within the dermis.

Tow plexuses of blood supply are found :

- **Cutaneous plexus:**
- **Sub papillary plexus:**



Sensory receptors of the Skin

In epidermis:

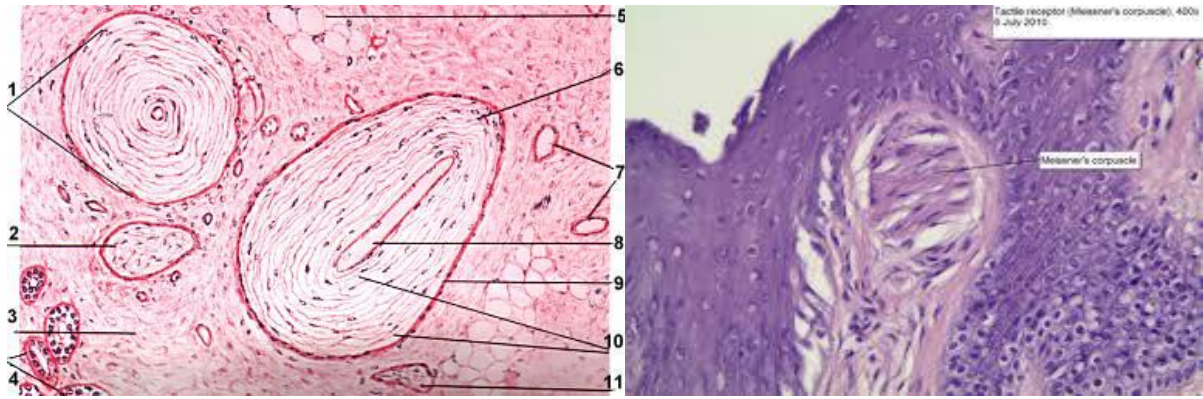
- **Merkel cells = touch**

The receptors are located mainly in dermis

- **Free nerve ending = for pain, temp**
- **Ruffini end-organ = continuous touch**
- **Encapsulated nerve ending: Meissner's corpuscles and pacinian corpuscles.**

What are Meissner's Corpuscles and pacinian corpuscles?

Where is their location, function, and their features? (see your text book)



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Skin appendages

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The objectives:

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- **TO know abbot the accessory structures(hair, nails and glands of skin).**

To know the histological features of hair follicles , sebaceous glands, sweat glands , and the nails.

Hair and hair follicles:

- **Hair is a nonliving keratinized structure composed of hard keratin toughened by bonds between proteins.**
- **Hair found almost everywhere on the body extends beyond the surface of the skin, produced by hair follicles.**

Chief parts of a hair

- **Root – imbedded in the skin**
- **Shaft – projects above skin's surface**
- **Development of hair**
 - **Is developed from epidermis as thickening of epidermis; down growth into the dermis as (hair follicle) forms (hair bulb) which is at deep end expanded and enlargement of follicle .**

Hair bulb composed of germinal cells, undergo division to produce (hair shaft), there are melanocytes in hair bulb responsible for hair color.

Hair bulb is invaginated at its lower end by connective tissue of dermis, and called hair papilla that supplied with sensory nerve ending and small blood vessels.

- **Hair follicle is composed of:**
- **Internal root sheath: is composed of many layers of cells from epidermis**

- External root sheath; single layer of epithelial cells at hair bulb, near the surface of skin this sheath is composed of several layers.
- Connective tissue root sheath is derived from the dermis (surrounds the hair follicle).
- There is glassy membrane which is a thickened basement membrane separate the dermis from external root sheath.

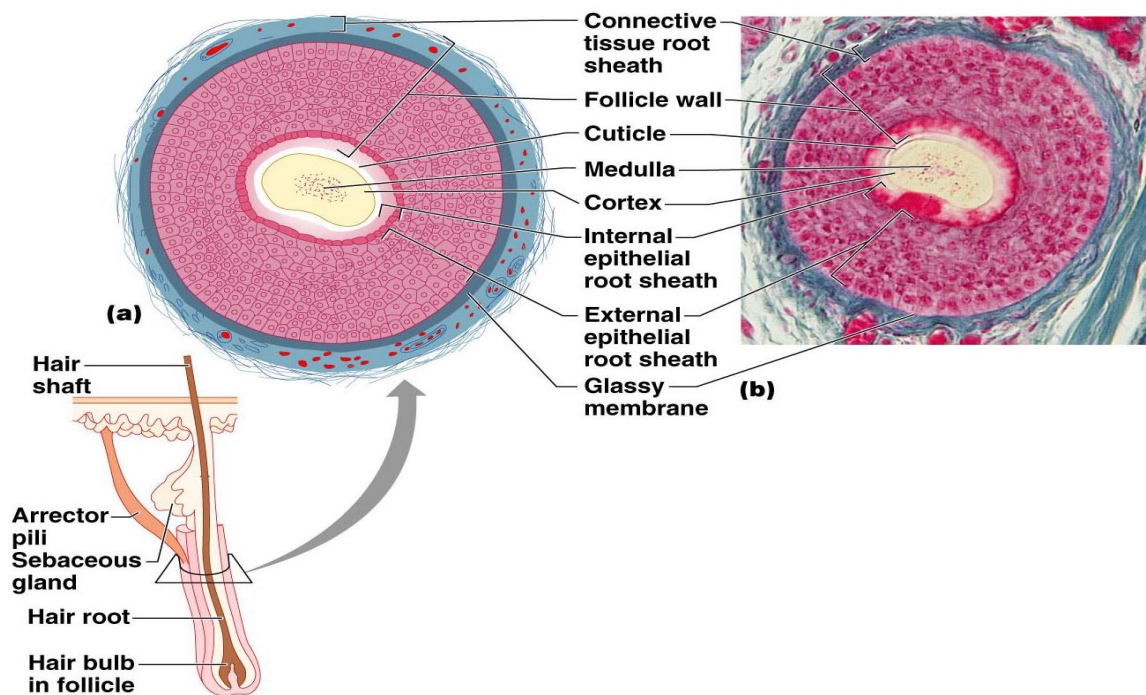
Hair Shaft organized into three concentric layers

- Medulla – central core
- Cortex – surrounds medulla
- Cuticle – outermost layer

1. Medulla = central part; 2-3 layers of polyhedral shaped and cornified cells.

2. Cortex = several layers of flattened cornified cells, it has pigment for hair color.

3. Cuticle = A single layer of cells holds the hair in the follicles.



Arrector pilli muscle

Smooth muscle fiber; run obliquely, attached to hair follicle; one end attached to the connective tissue sheath, other end to the dermal papilla in dermis. By its contraction, makes the hair in vertical manner.

Sebaceous glands

Branched alveolar glands, attached to hair follicle. Each gland composed of numbers of polyhedral cells have dark stained nucleus, they are surrounded by single cuboidal or flat cells rest on the basement membrane.

They have ducts opened on the upper part of hair follicle and lined with stratified squamous epithelium.

Sweat glands

Un branched tubular coiled gland.

Developed as down growth of epidermis into the dermis; as long coiled tube, has 2 portions:

Secretary portion and duct or excretory portion

Eccrine sweat glands

They are simple coiled glands.

Have secretary segment located deep in the dermis or upper hypodermis, and have duct leads to the surface.

It is merocrine gland. They regulate body temperature.

They secret watery solution containing Ions = Na^+ , K^+ , Cl^- .

In secretary region there are clear cells that produce the watery component of sweat and dark cells that produce a proteinaceous secretion .

There are myoepithelial cells that are responsible for the expression of sweat from the gland.

- What are myoepithelial cells?
- Where is their location? (see your text book)

Apocrine glands

- Are found in axilla, areola of nipple, eyelids, thick secretion rich in organic substance its duct opened into hair follicle have large lumen associated with hair follicles.

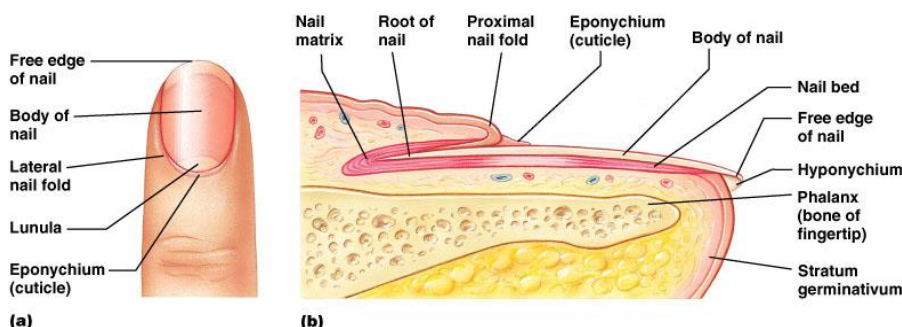
They develop from the same down growths that give rise to hair follicle.

Nails:

- Scale-like epidermal structure
 - Cells bind together and have “hard” keratin
 - Grows out from root of nail
- Is derived from invagination of epidermis to form nail plate ,rest on nail bed which is epithelial cells St. basale and spinosum. The nail is embedded in depression called nail fold.

The proximal part of the nail is the nail root and is covered by a fold of skin, from which the epidermal stratum corneum extends as the cuticle, or eponychium. The nail plate is bound to a bed of epidermis, the nail bed, which contains only the basal and spinous epidermal layers

Horny cuticle fold at the proximal part of nail is (eponychum), while at distal part the fold turn into (hyponychum).



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Note: (see your text book for related figures)