

Histology

faculty of medicine - JU2015

Lecture 13

SKIN

(Integumentary System)

By Motasem Abu-Mallouh

Dr. HebaKalbouneh

- Integument (in Latin): to cover
- The skin covers the outer surface of our bodies and it is continuous with the mucus membranes (the oral cavity or nasal cavity for example)
- The skin (known as “cutaneous membrane”) is composed of two layers:
 - 1- Epidermis : keratinized stratified squamous epithelium
 - 2- Dermis : (Derma = skin) is a connective tissue
- Below the skin is the subcutaneous layer which is also called hypodermis because it is located under the dermis
- Hypodermis is adipose tissue and in anatomy it is the superficial fascia and it is NOT part of the skin
- Under the hypodermis you can find the muscles.

Skin appendages (accessory structures associated with the skin):

- 1- hair follicles: Invaginations from epidermis into dermis where we can find the hair shaft
- 2- Sweat glands
- 3- Sebaceous glands which open on the hair follicles.
- 4- Nails

➤ Major functions of the skin:

1- Protection from the outer environment and microorganisms

2- Protection of our DNA from the ultraviolet light

3- Prevention of water loss by forming impermeable layer and conservation of water inside our body

4- Thermoregulation :

a- Hot weather >> sweating >> cooling body's temperature

b- Cold weather >> hair terminals will stand up to close pores and prevent heat loss >> keeping the body warm

5- Sensation : a lot of nerve endings that sense pain, touch, pressure, and temperature are located in the skin (sensory receptors)

6- Excretion : sweat (water and other electrolytes)

7- Formation of vitamin D

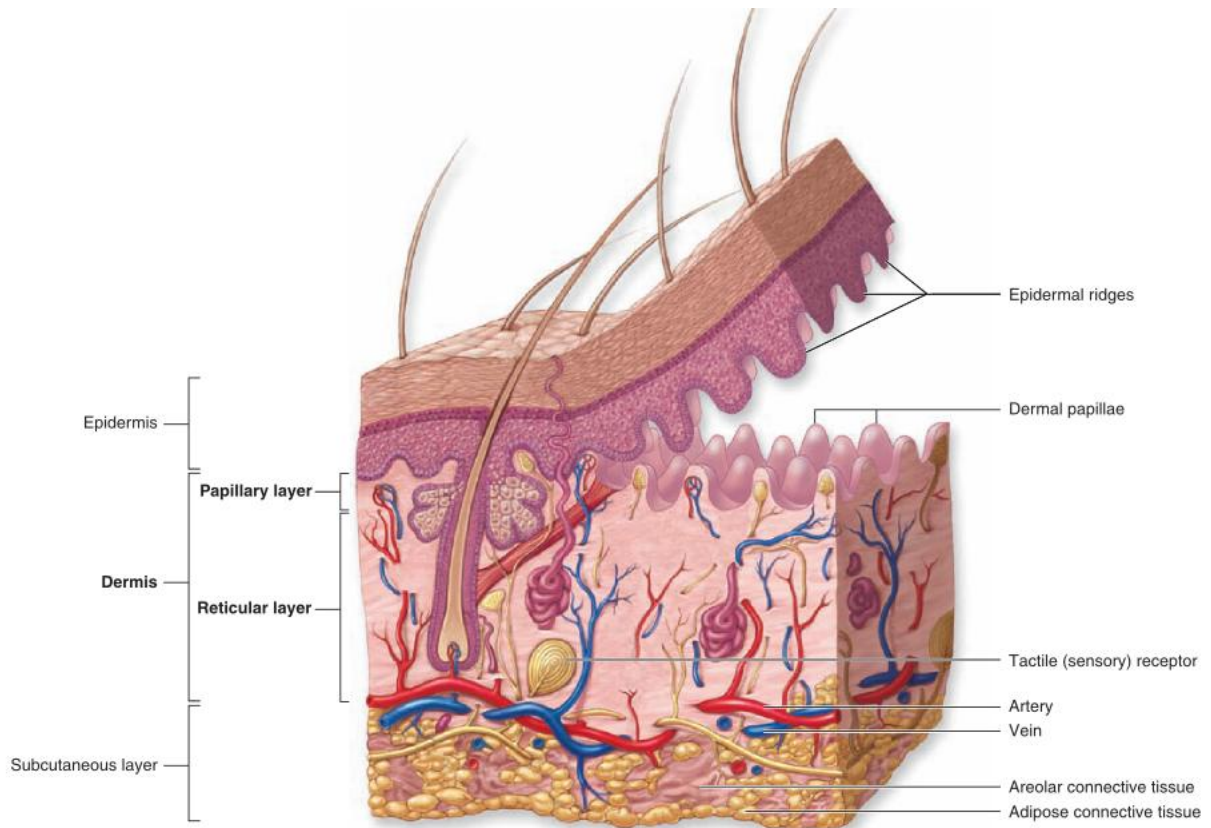
➤ Skin is an organ, it is NOT a tissue, it is composed of different tissues (epithelium and connective tissues for example) and each tissue has a different origin

Epidermis: originates from ectoderm

Dermis: originates from mesoderm

➤ Skin is the largest organ in our body; it weighs about 5 Kg and covers an area up to 2 m²

- **Epidermal-dermal junction** is the junction between epidermis and dermis, we mentioned that the epidermis is epithelial tissue and the dermis is connective tissue, so the epidermal-dermal junction represents the **basement membrane** of the epithelial tissue
- This basement membrane is a **wavy** line, not a straight line, because there are invaginations from epidermis toward the dermis and we call these **epidermal ridges**.
- And there are invaginations in the opposite direction (toward the epidermis), the part of the dermis that invaginates inside the epidermis is called **dermal papilla** (papilla means nipple like structure, pl. papillae).
- This wavy junction is important to increase surface area of **adhesion**, and to increase the surface of **diffusion**; because epidermis is avascular so it gets its nutrition from vessels in the dermis.
- These invaginations are more prominent in the palms of hands and in soles of feet. Also, these invaginations create a unique pattern for each individual called **fingerprint and footprint**; these are so unique and can't be identical even between identical twins!



Epidermis:

Layers of epidermis:

- The lowermost layer (right above the basement membrane) is a single layer of **cuboidal** cells (or **columnar** cells), this layer is called **Stratum Basale**, and its cells are characterized by **mitotic activity**. Cells of Stratum Basale are connected
 To each other by **desmosomes**
 To the basement membrane by **hemidesmosomes**
- The second layer (above Stratum Basale) is called **Stratum Spinosum** and it is composed of more than one layer of cells, the shape of these cells is polyhedral, but it appears spinous in shape in

histological preparation. The spinous appearance in this layer is due to desmosomes (during preparation, the cells shrink and the spines represent the areas of desmosomal attachments between the cells)

- Note that the skin cells have high amount of desmosomes

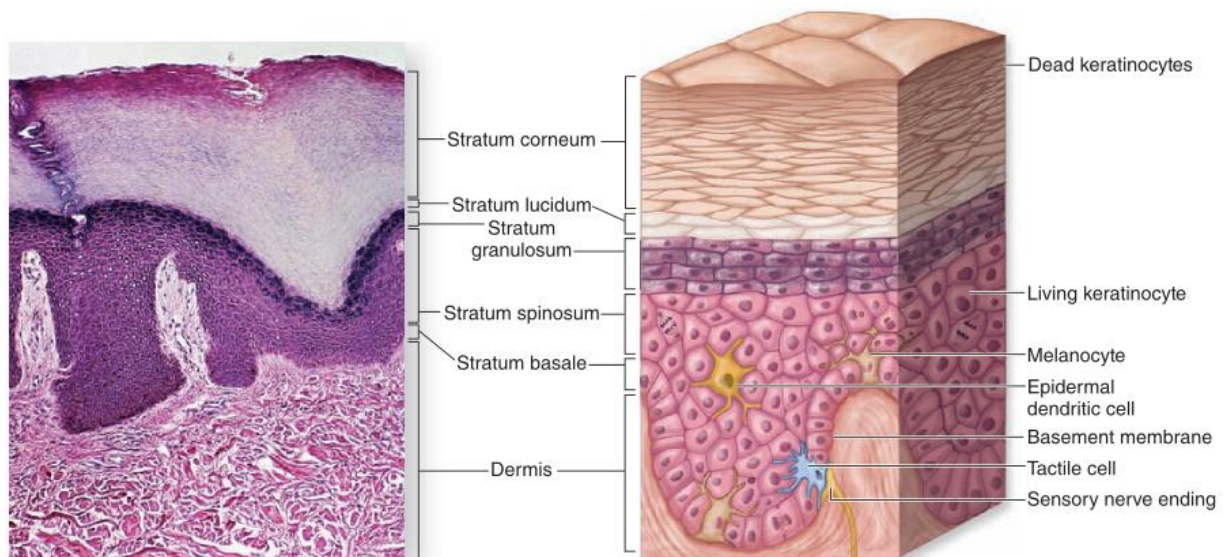
In the lower part of this layer we can find some **mitotically active cells** (as in Stratum Basale) and we refer to these two layers together [Basale and lower part of spinosum] as **Stratum Germinativum**.

- The third layer is **Stratum Granulosum**, it is named “granulosum” because we can find basophilic granules in its cells’ cytoplasm, Its cells are flat and connected to each other by desmosomes. The basophilic granules are keratin granules and we can call them **Keratohyaline granules**.
- There is another type of granules in these cells, **lamellar granules**, they are called lamellar because they show lamellar pattern (composed of layers) when viewed under the **electron microscope**, lamellar granules contain **lipids**, and by exocytosis the lipids will be discharged from the cells, and form a lipid rich layer around the cells (impermeable layer that prevents water loss or gain)

Keratohyaline granules	Lamellar granules
Basophilic (visible under light microscope)	Not visible under light microscope (only under E.M.)
Not surrounded by a membrane	Surrounded by a membrane

**** Granules start appearing at the upper part of stratum spinosum ****

- The fourth layer is the **Stratum Lucidum**, it has flat cells which are **dead and full of keratin**, and it is 3-4 layers of cells.
- The fifth layer is **Stratum Corneum**, its cells are dead, filled with keratin, and surrounded by lipid layer (from lamellar granules)



Why do the cells die as we go upward??

Because they are pushed farther away from blood supply (the shedding of the dead cells is called **desquamation**)

Again, epidermal cells are connected to each other by desmosomes, and the desmosomes – as you know – are connected to intermediate filaments in the cytoplasm, these filaments are keratin in the skin.

As we go up in epidermis, synthesis of keratin intermediate filaments increases.

Keratin filaments are called **tonofilaments**, these tonofilaments are packed gradually as we go up and cross-linked with each other by linker proteins like **Filaggrin protein** to create thick bundles called **tonofibrils**.

The process of keratin synthesis and accumulation is called **keratinization** (or maturation), and it occurs in all cell stages of epidermis until the cell is dead; and that is why cells of skin are called **keratinocytes**.

Keratinocytes count for 90% of the cells of epidermis, and the epidermis contains other types of cells (less in number) like:

- **Melanocytes:** this type produces **melanin**, and they are located in **Stratum Basale** and connected to the **basement membrane** (only to it) by hemidesmosomes, but they are NOT connected to keratinocytes.
 - Melanocytes have many processes that run between keratinocytes.
 - Melanocytes synthesize melanin (**melanosomes**), but they **don't store it** in their cytoplasm.

- Melanosomes are transported to the tips of the cytoplasmic processes of melanocytes to enter the keratinocytes by **phagocytosis**. WHAT?!
Yes, keratinocytes phagocytose the tips of melanocytes' processes to get the melanin.
- When melanin enters the keratinocyte, it will form a structure like an **umbrella above the nucleus to protect it from ultraviolet light**.
- Lighter colored people (less melanin) are more prone to develop skin cancer than darker colored people.
- NOTE: melanin is not the only pigment that contributes to the color of the skin, there are other pigments that participate, like **Carotene pigment** (people who eat lots of carrots become orange in color)
- Carotene accumulates in adipose tissue (hypodermis), and Stratum Corneum. The blood flow toward the skin may also contribute in coloring the skin (become red like in blushing).

- ❖ The number of melanocytes is equal in all humans but **their activity** may differ.
- ❖ The number of melanocytes is **1 cell for each 5-6 keratinocytes of Stratum Basale**.
- ❖ Under the light microscope, you can see these cells **rounded** in shape and have a **clear** cytoplasm. They have **fine processes** passing between the keratinocytes but you can't see them.

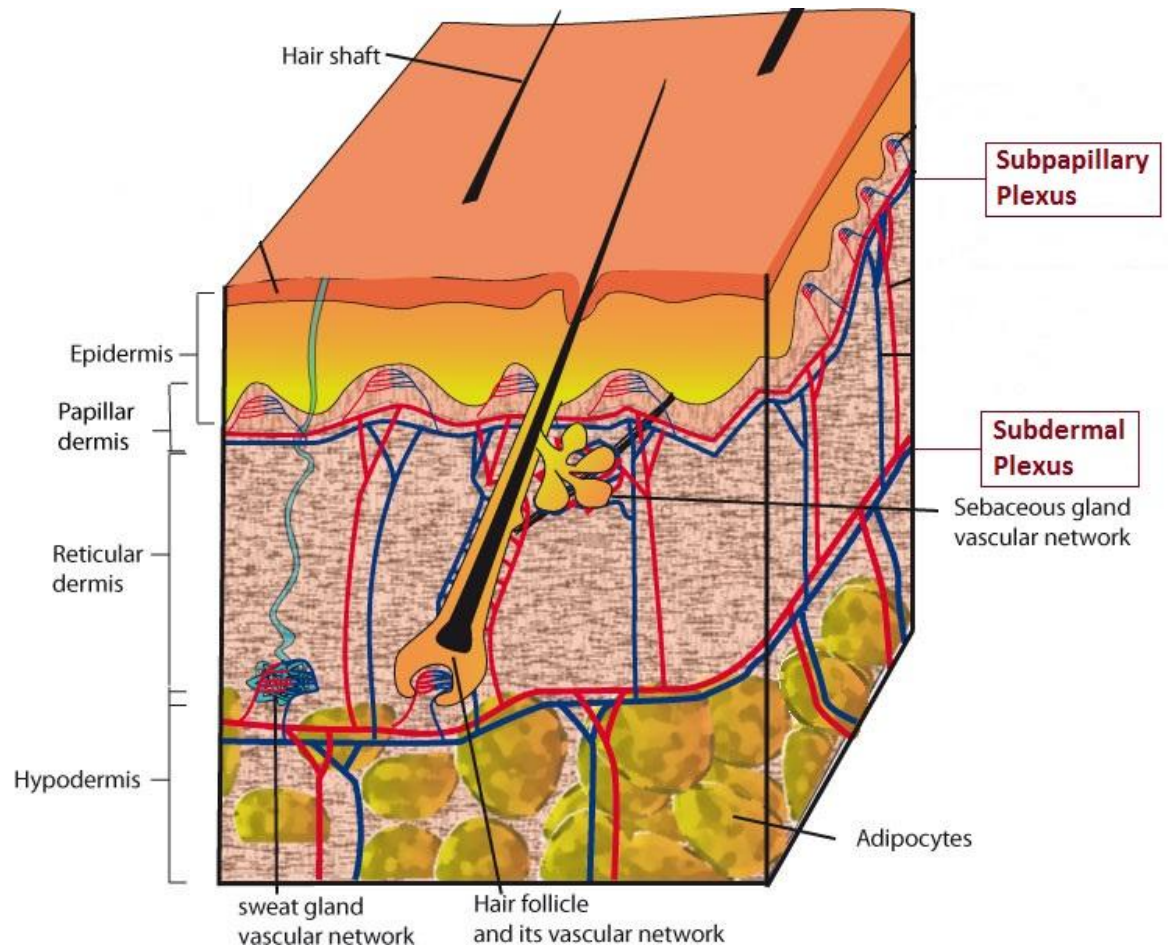
- **Langerhans cells:** which are macrophages in the skin
These cells are found mainly in stratum spinosum but you can also find them in other layers.
They form 2-8% of cells in the skin.
- **Merkel Cells:** Found in stratum basale and have many processes
They are attached to basement membrane by hemidesmosomes and to other keratinocytes by desmosomes.
They have the same origin of the keratinocytes (ectoderm).
They are involved in **tactile sensation** (our sense of touch).
They are associated with sensory neurons, this structure is called **Merkel's disk** (which is a type of sensory receptors, and it belongs to **mechanoreceptors**).
They are more prominent in **finger tips**.

Dermis:

- The upper part of it is **loose** connective tissue, it is called **papillary layer** of dermis.
- And the lower part is **dense irregular** connective tissue, it is called **reticular layer** (but this doesn't mean it contains reticular fibers!) it is named reticular because **collagen** fibers and **elastic** fibers form network structure. It is **thicker** than loose connective tissue.
- There are blood vessels exactly under the papillary layer (**subpapillary plexus**).

- And blood vessels between the dermis and the hypodermis (**Subdermal plexus**) >> these give branches to form subpapillary plexus and they are important in **controlling body heat**

(When the weather is cold the diameter of these vessels **decreases**, decreasing blood flow toward the skin, **preventing heat loss**)

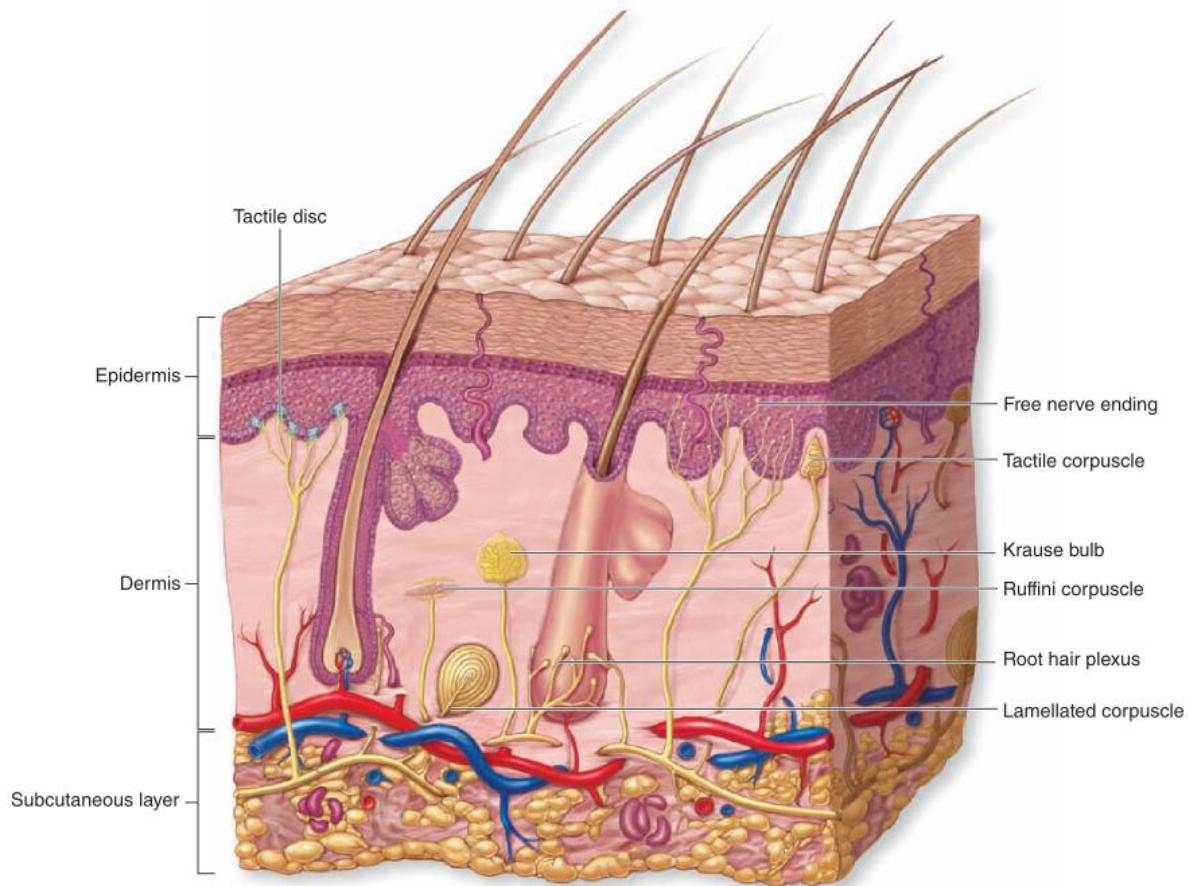


Sensory receptors:

Sensory receptors which are surrounded by a capsule are called encapsulated sensory receptors, Examples:

- 1- Meissner's corpuscles, which present in dermal papillae and are responsible for light touch reception, more prominent in fingertips.
- 2- Pacinian corpuscle, which present in reticular layer of dermis or sometimes can reach the hypodermis, they are responsible of transmission of deep pressure.
- 3- Ruffini's corpuscle, fusiform in shape, which present In reticular layer of dermis, respond to stretch (tension) or twisting in the skin

If they are not surrounded by a capsule they are called **unencapsulated** sensory receptors or nerve endings. (Examples: Merkel's disk, free nerve endings for pain and temperature)
At the end of hair follicle you find **root hair plexus**, which detects the movement of the hair.



- There are two types of skin: thin skin and thick skin
- These two types refer to the thickness of the EPIDERMIS not for the whole thickness of the skin.
- Thick skin refers only to the skin of the palms of hands and soles of feet, and skin of the rest of the body is thin skin.
- Thick skin is always **non-hairy** and has **no sebaceous glands** (but of course it has eccrine sweat glands)
- Epidermis of thick skin has 5 layers (mentioned earlier). whereas in thin skin, the epidermis **lacks stratum lucidum** (so it is only 4 layers)
- The skin of the back (which is 4 mm thick) is considered thin skin same as the skin of the eyelids (which is 0.1 mm thick)

because they have almost the same epidermis (but the difference is in the thickness of the dermis).

Source of figures: Janqueira's Basic Histology text & atlas 13th edition.