



Tranes Integumentary

Medical Technology (Universidad de Zamboanga)



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Skin and Its Appendages

The skin or *Integumentary* is the tough protective, external covering of the body that is continuous with the mucosa (mucous membrane) that lines the mouth, nose, anal canal, genital openings, and eyes.

- The largest organ of the body accounting for about **15% of a person's body weight**.
- Its surface area in adults exceeds **1.5m²**.
- **0.5 to 5.0 thickness** depending on the location
- Thinnest in eyelids
- Thickest in soles of the feet.

FUNCTIONS:

- Prevents harmful substances to enter the body
- Prevents loss of fluid
- Protects other tissues of the body
- Forms sweat to regulate body temperature
- Excretes waste materials and waste products.
- Serves as a huge sense organ for sensory.
- Some of its cells assist in the immune response (immune defense) of the body.
- Site for vitamin D production which occurs when 7-dehydrocholesterol that is present in its epithelial cover reacts with ultraviolet light from the sun.

TWO (2) PROPERTIES OF THE SKIN

1. The skin is being a semipermeable membrane, can absorb certain substances from its surface, hence, some pharmaceutical preparations are specifically design for absorption through the skin.
2. In the fingertips, the skin exhibits shallow grooves and ridges whose patterns are unique for each person. These grooves and ridges, which are collectively referred to as finger prints which is used as basis for individual identification.

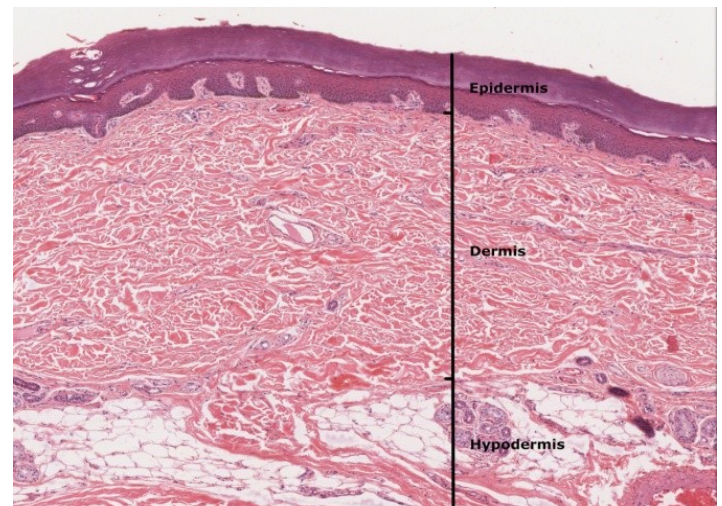
Associated with the skin are several structures, collectively referred to as **appendages of the skin**. This consists of *nail, hair, and cutaneous gland-sweat and sebaceous gland*.

This skin and its appendages are often referred to as the **integumentary system**.

LAYER OF THE SKIN

Histologically, the skin consists of two direct layers:

1. **Dermis** – (or corium) is made up of connective tissue derived from *mesoderm*.
 - Tissue elements of the dermis form irregular conical projections called **dermal papillae**.
 - The dermis is anchored to the underlying tissues by loose connective tissue that is referred to as **hypodermis** or **subcutaneous tissue** that often contains numerous adipose cells.
2. **Epidermis** - is more superficial layer and an **epithelial coat** derived from *ectoderm*.
 - Tissue elements from the epidermis form irregular conical invaginations **epidermal ridges** invade the dermis.
 - Is a **keratinized stratifies squamous epithelium** and sheds to be completely renewed every 20-30 days. This renewal process is the responsibility of the **keratinocytes**, the principal cells of the layer.



Keratinocytes

Keratinocytes comprise 85% to 95% of the cell population of the epidermis.

- They are cells that are specialized to produce **keratin** which is an intermediate filament that is also present but in much lesser amounts in other epithelial cells.
- Keratinocytes in the deep layers of the epidermis divide continuously either to renew their numbers or to differentiate and keratinize (i.e. produce and accumulate keratin in their cytoplasm).
- As differentiated keratinocytes grow older, they are slowly pushed towards the surface of the epithelium by newly formed and younger cells. At the same time, they accumulate increasing amounts of keratin and become bigger. When they are already near the surface, they dry up, become smaller then die, and ultimately get shed off.

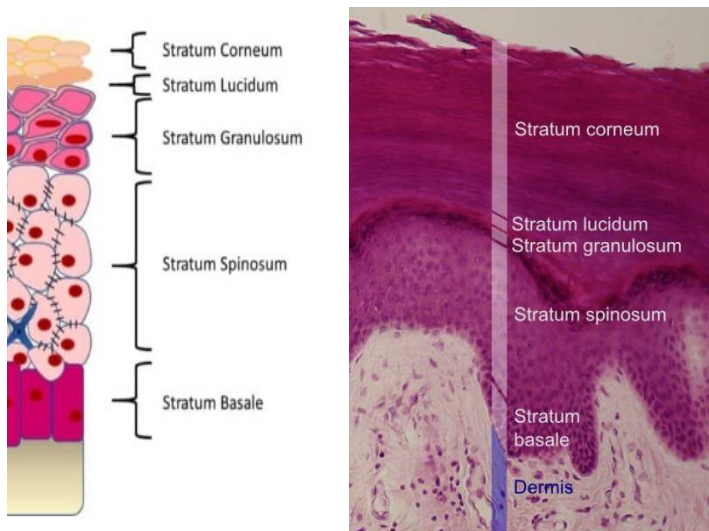
Types of skin

Skin is categorized into two types: **thick** and **thin**.

Thick skin

Thick skin covers the **palms** and **soles**. Its epidermis consists of five layers. From the deepest to the most superficial, these layers are:

- a. Stratum germinativum (stratum basale)
- b. Stratum spinosum (prickle cell layer)
- c. Stratum granulosum
- d. Stratum lucidum (clear layer)
- e. Stratum corneum (horny cell layer)



A. Stratum germinativum (stratum basale)

- Consists mainly of a single layer of tall cuboidal keratinocytes that rest on the basement membrane w/c consists of basal lamina that is supported in its deep surface by lamina fibroreticularis.
- The keratinocyte in the stratum germinativum has a large nucleus and basophilic cytoplasm that contains numerous ribosomes, a Golgi complex, ER, a limited number of mitochondria, and a few keratin filaments.
- They are bound on their lateral and upper surfaces to neighboring cells by desmosomes and to the basal lamina by hemidesmosomes.
- The keratinocytes in the stratum germinativum divide continuously; hence, in routine histologic preparation, many mitotic figures are seen among cells.

B. Stratum spinosum (prickle cell layer)

- Consists of polyhedral keratinocytes that are arranged into several layers.
- Keratinocytes are shorter and less intense basophilic; their keratin filaments are more numerous and they form bundles.
- The keratinocytes in the stratum spinosum are still tightly bound to their neighbors by desmosomes. Incidentally, desmosomes are the only cell-to-cell junctions that exist among the cells of the epidermis.
- Under the light microscope, because of shrinkage caused by routine preparations, the desmosomes appear like spines or hair that protrude out of the cells. These spines, the reason why the layer is called stratum spinosum, are often referred to as "**intercellular bridge**." They are merely preparation artifacts.

C. Stratum granulosum

- Consists of 3-5 layers of keratinocytes are more flattened than those in the stratum spinosum.
- Keratinocytes contain numerous dark, basophilic **keratohyaline granules** in their cytoplasm.
- The keratohyaline granules contain a histidine-rich protein called **profillagrin**, which, when the cells reach the stratum corneum, becomes **fillagrin** that provides the interfilamentous matrix for the aggregation of keratin filaments.
- Another feature of the cells in this layer is the presence of membrane-bound, lipid

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containing secretory granules (**lamellar granules**) in the cytoplasm. They consist of closely-packed parallel lamellae.

D. Stratum lucidum (clear skin)

- The stratum lucidum is a discontinuous layer that lies on top of the stratum granulosum and is primarily made up of 4-6 layers of flat, dead, anucleate keratinocytes.
- The keratinocytes in this layer have already lost their organelles, but they are still connected to their neighbors by desmosomes and form thick bundles that run parallel to the skin's surface.

E. Stratum corneum (horny cell layer)

- The stratum corneum is composed of 15 to 20 rows of flattened keratinocytes with keratin filaments and amorphous matrix entrenched in their whole cytoplasm.
- Desmosomes still hold the deeper cells to one another, albeit loosely, but those in the surface layers, which make up the stratum dysjunctum, are free from one another and are continuously shed off or desquamated.

Thin skin

The soles and palms are the only parts of the body without thin skin. Its stratum spinosum is significantly thinner than that of thick skin, and its stratum granulosum is less developed or even missing. It also lacks a stratum lucidum and has a thinner stratum corneum than that of thick skin.

The epidermis of thin skin has only 3 layers:

- Stratum basale
- Stratum spinosum
- Stratum corneum

Other cell types in the epidermis

- Melanocytes
- Langerhans cells
- Merkel cells

Melanocytes

- Melanocytes are cells with the specific function of making the pigment melanin. They can be found in some areas of the body, particularly the skin and the uvea of the eye. They are second in number to

keratinocytes in the skin, making up 7%–10% of the epidermis's cell population. Additionally, there are some melanocytes in the dermis's superficial layer. The cells of the stratum germinativum and stratum spinosum in the epidermis are scattered with melanocytes.

- In H&E preparation
 - Melanocytes appear as “clear” cells
 - They can be distinguished with the aid of special methods such as DOPA technique
- When incubated in a solution of 3,4 dihydroxyphenylalanine (DOPA)
 - The melanocytes are selectively blackened and the cells become recognizable
- Small cells called melanocytes that are in contact with nearby keratinocytes have long but thin processes.
- Organelles abound in their cytoplasm, which also houses a significant number of electron-dense, membrane-bound granules called melanosomes.
- Since melanin is produced inside of the melanosomes, many authors believe that these cytoplasmic organelles are specific to melanocytes.
- Melanin is formed from the amino acid tyrosine through a series of enzyme-catalyzed chemical reactions.
- The melanin that a melanocyte produces is transferred in a continuing manner, via the melanocyte's processes, to the keratinocytes with which it is in contact.
- In the keratinocytes, the melanosomes become permanent inclusion and are positioned in the supranuclear portion of the cells in order to protect the cells from solar radiation.
- The transfer process of melanosomes from melanocytes to keratinocytes is still a poorly understood process, but it is so efficient that, in general, keratinocytes contain more melanin than melanocytes.
- An epidermal melanin unit is the term for a group of melanocytes and the keratinocytes they supply with melanin.
- Skin color is admixture of 3 pigments:
 - **Carotene** - present in the intracellular substance of the epidermis that gives the skin a yellowish hue.
 - **Hemoglobin** - (the red oxygen carrying pigment present in the RBC

that circulates in the capillaries of the dermis.

- **Melanin** - that gives the skin its brown and black shade.
- **Neural crest** - this is where the melanocytes cells arise from.
- **Melanocytes** - colonize the epidermis during the early embryonic period.

Langerhans cells

- Antigen-presenting cells (apcs) present in:
 - Skin
 - Epidermis (comprises 3% to 8% of cells)
 - Numerous in stratum spinosum of epidermis
 - Dermis (limited number)
 - Stratified squamous epithelia
 - Oral cavity
 - Esophagus
 - Vagina
- In H&E (hematoxylin and eosin) preparation:
 - Similar to melanocytes (dark nucleus and pale-staining cytoplasm)
- In staining with gold chloride:
 - Dendritic nature of processes become apparent and distinguishable
- In electron micrographs:
 - Easy to identify in epidermis (they lack desmosomes and keratin filaments)
 - They contain Birbeck granules or vermiform granules: (rod-shaped, membrane bound granules)
Undetermined function
- Langerhans cells are derived from the bone marrow in the embryo
- They colonize the skin as early as the 5th or 6th week of embryonic life
- Postnatally, they retain some mitotic activity
- Renew their numbers by migration of precursor cells via blood to the skin
- Precursor cells are misidentified as monocytes in the blood

Merkel cells

- Least in number among the cell types in the epidermis
- Occasionally occur in clusters in the basal region of the epidermis
- Numerous in the palms and soles
- In routine histologic preparations:
 - Appear as “clear cells” like melanocytes and langerhans cells
 - Distinguishable under the light microscope if specific immunohistochemical techniques are applied
 - Merkel cells are disc-shaped cells with short cytoplasmic processes
 - Bound to neighboring keratinocytes by desmosomes
- In electron micrographs:
 - Their cytoplasm is devoid of keratin filaments (small, dense granules that contain a hormone similar to the catecholamines secreted by the adrenal medulla)
- Merkel Disc
 - Formed by Merkel cell together with an axon termination of a sensory neuron
 - Sensory mechanical receptor that responds to pressure and touch
 - A single afferent nerve fiber (axon) which has numerous terminations, makes contact with many Merkel cells.
- **Merkel cells are prevailed as modified keratinocytes.**

Dermis (Corium)

- Thicker than the epidermis
- Ranges from 0.6 mm (in the eyelid) to 4.0 mm (in the back)
- Composed of connective tissue that forms two histologic layers:
 - a) **Papillary**
 - b) **Reticular**

A. Reticular Layer

- Thicker than the papillary layer
- Responsible for the toughness and strength of skin
- Consists of dense irregular connective tissue:
 - Richly supplied with blood vessels
 - Its collagen fibers form coarse bundles that are parallel to the skin
- Network of elastic fibers
 - Dispersed within the reticular layer
 - Thicker than those in the papillary layer

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- Sweat glands, sebaceous glands, and hair follicles
 - When present, are embedded in the connective tissue of the reticular layer
 - Smooth muscle cells are present in reticular layer of the dermis
- Arrector pili muscles
 - Formed when associated with hair follicles
- Smooth muscle fibers
 - Form interlacing bundles of in the deep layers of reticular layer such as:
 - Scrotum in males
 - Areola of the breast in females
- In the head and neck
 - Connective tissue bands serve as insertions of skeletal muscles that comprise the muscles of facial expression
 - The undersurface of the reticular layer of the dermis merges with the hypodermis

B. Papillary Layer

- More superficial of the two layers of the dermis
- Made up of loose connective tissue
- Well-demarcated from the epidermis by the latter's basement membrane
- Dermal papillae
 - Connective tissues that comprises the papillary layer from conical projections into the epidermis
 - Numerous in soles of the feet (subjected to pressure)
 - Contains a capillary bed in the core that supplies the epidermis with blood and nerve endings like Meissner's corpuscles

Hypodermis (subcutaneous tissue)

- Refers to loose connective tissue that binds the dermis of the skin to the underlying structures.
- Also allows the skin to slide over the underlying structures.
- Subcutaneous tissue is not a part of the skin
- **Contains** - adipose cells except over the eyelids, Penis, Scrotum, Nipple, areola.
- **Panniculus adiposus**
 - Layers that formed in adipose tissue
- Sebaceous and sweat glands sometimes extend to the hypodermis

- Hair follicles also often invade the hypodermis.

Nerve Endings in Skin

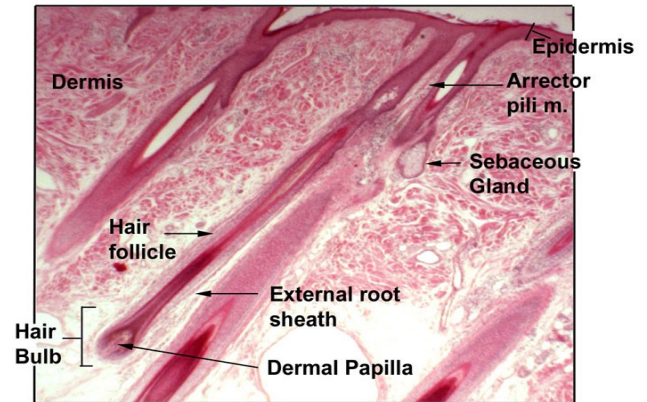
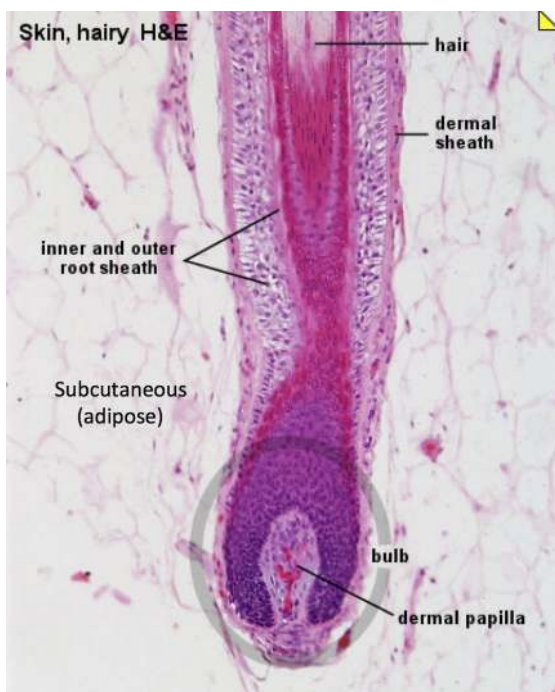
- **Main functions**
 - Is to receive and transmit sensory stimuli to the central nervous system.
- **The sensory nerve endings consist of three groups:**
 - Simple nerve endings (free nerve endings)
 - Expanded-tip nerve endings (merkel discs)
 - Encapsulated nerve endings:
 - Ruffini's corpuscles
 - End bulbs of Krause
 - Vater-pacinian corpuscles
 - Meissner's corpuscles

APPENDAGES OF THE SKIN

- The appendages of the skin are structures that are derived from the **epidermis**.
- **Consists of:**
 - **Hair**
 - **Nail**
 - **Cutaneous glands (Sebaceous and Sweat glands)**

HAIR

- Filamentous, keratinized structure that covers practically the whole body but there are exceptions this includes;
 - Lip
 - Palms
 - Soles
 - Distal
 - Dorsal parts of the fingers and toes
 - Prepuce and Glans of the penis
 - Labia minora and Inner surface of the Labia majora
 - Clitoris and
 - Nipples
- Varies in **thickness**, **growth**, and **pattern** in the different regions of the body.
- Hair is particularly **lush on the scalp** and the bearded areas of the face and the neck.
- Important for **sense of touch**.
- The part of the hair that projects from the surface of the skin is called **shaft**. Then the part that is embedded on the skin is called the **root**.



Hair Follicle

- A hair root and its sheaths comprise a **hair follicle**. Each hair root is enclosed by two epithelial sheaths (**external** and **internal** root sheaths)
- **Associated with each hair follicle;**
 - **Sebaceous glands** - ducts open into the **upper third of the follicle**.
 - **Arrector pili muscle** - thin smooth muscle whose one **end is attached to the connectivetissue** surrounding the hair;
 - This muscle courses close to the sebaceous glands that are associated with the hair follicle before it attaches to the dermis.
- Contraction of the arrector pili muscle strengthens the hair and forces out the secretions from the acini of sebaceous glands.
- Simultaneous contraction of numerous arrector pili muscles results in "**goose pimple**" or "**goose flesh**"

Hair bulb

- **Expanded, bulbous proximal portion** of the hair follicle.
- The base of the hair bulb has a deep concavity that is occupied by;
 - **Hair Papilla** which consists of connective tissue where capillaries that supply the hair follicle with **nutrients** and **oxygen** are embedded.
- Hair papilla has an inductive effect on the cells that produce hair and is the lifeline of hair follicles.
- The epithelial cells in the hair bulb that is associated with hair papilla form the hair matrix (**hair root, to some authors**)

Hair Formation and Growth

- Formation of the hair is similar to cells; anchored on the mitotic activity of the cells in the stratum germinativum.
- In hair, stratum germinativum of the epidermis are the cells of the hair matrix;
 - They **proliferate and get pushed upward** as they differentiate, degenerate and die.
- Hair forming cells produces **keratin**, but the keratin that is produced is hard keratin.
- **Melanocytes**- cells responsible for the **color of the hair** and produce **melanin** which they transfer to other hair matrix.
- Cells in the hair matrix differentiates into several cell types that occupy the central region of the hair matrix.
- Distinct concentric histologic layers of Mature Hair:
 1. **Medulla** - occupies the **core of the hair**, surrounds the apex of the dermal papilla, when these cells differentiate, they transform into **large vacuolated cells** with little keratin filaments.
 2. **Cortex** - surrounds the medulla and is the thickest on the concentric layers of hair, when these cells differentiate, they transform into **fusiform cells** that synthesize a large amount of keratin filaments.
 - They also produce;
 - Trichohyalin granules which contains **trichohyalin**
 - **Fillagrin**- intermediate filament associated protein that serves to aggregate keratin filaments bundles.
 - The cells of the cortex also receive a greater number of **melanosomes** from the **melanocytes**.
 3. **Cuticle** - thinnest of the three concentric layers of hair, when these cells differentiate, they transform into **flattened cells** that synthesize a lot of keratin.
- Hair does not grow continuously. A hair follicle has;
 - **Anagen** - active growth period

- **Telogen** - rest period

➤ Growth Periods

- **Scalp** lasts for 2-4 years and the rest period lasts for 3 months.
- Eyebrows last for 1 to 2 months and the rest period lasts for 3-4 months.
 - During the rest period of the hair follicle, the hair is shed, the hair papilla becomes rudimentary. The **follicle** becomes **smaller and shorter** and **melanocytes** become inactive.

SHEATHS OF HAIR

- It is the **internal root sheath** and **external root sheath** form of the outer layers of the hair follicle.
- **Internal root sheath**
 - The one that surrounds the initial segments of the hair.
 - Consist of three concentric layers.
- **External root sheath**
 - The one that envelopes the internal root sheath.
 - Consist of essentially epidermis of the skin that is pulled downward by the invaginating hair follicles
 - It exhibits all the layers of the epidermis of thin skin.

Nerves Associated with Hair

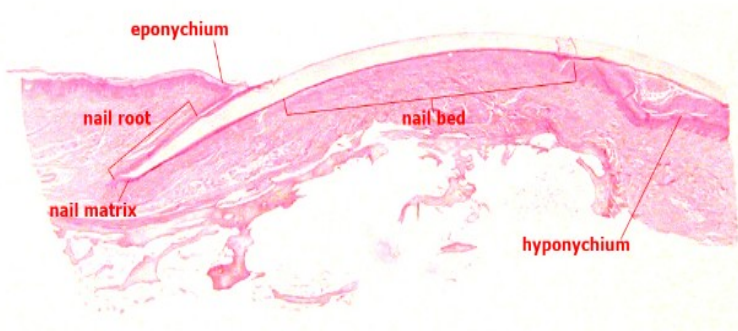
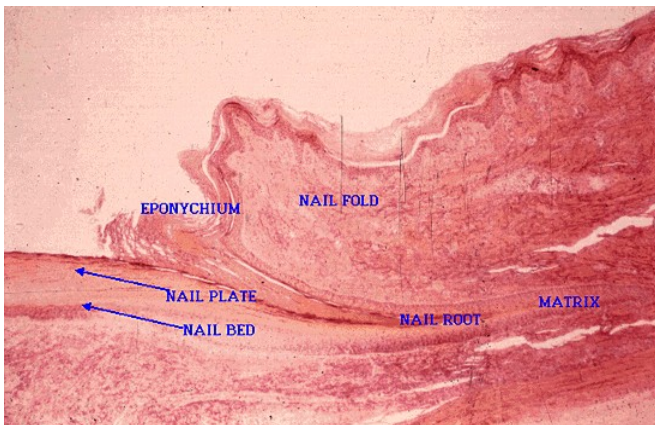
- **Hair** is a tactile organ and is richly supplied with free encapsulated nerve endings and lanceolate endings.
- **Lanceolate Endings**
 - Nerve endings that are in contact with hair bulb and it resembles Meissner's corpuscles structurally.

Nail

- Also known as **nail plates**.
- Consist of heavily keratinized epithelial cells that form protective covers on the dorsal surfaces of the terminal ends of the digits.
- Nails grow continuously.
- Fingers grow faster than those in the nail growth is the function of the cells of toes.
- **Nail plate**
 - Essentially synonymous with the stratum corneum of the epidermis.

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- Rests on a nail bed.
- Consists of stratum **spinosum** and **stratum germinativum**
- **Nail matrix**
 - Growth occurs at the **nail matrix**.
 - The most proximal portion of the nail
- **Nail root**
 - The proximal part of the nail plate.
 - Hidden in the **nail groove**.
 - It extends in the **lunula**; the white, crescent-shaped area at the proximal portion to the exposed nail plate to the **nail matrix**
- **Nail fold**
 - Covers the dorsal surface of the nail plate.
 - At the **lunula**; the distal end of the nail fold is highly keratinized and referred to as **eponychium (nail cuticle)**
- **Hyponychium**
 - Under the free end of the distal part of the nail.
 - A thickened accumulation of stratum corneum,
- **Nail growth**
 - Function of the cells of the nail matrix, which corresponds to the cells of the stratum germinativum of epidermis.



Sebaceous Glands

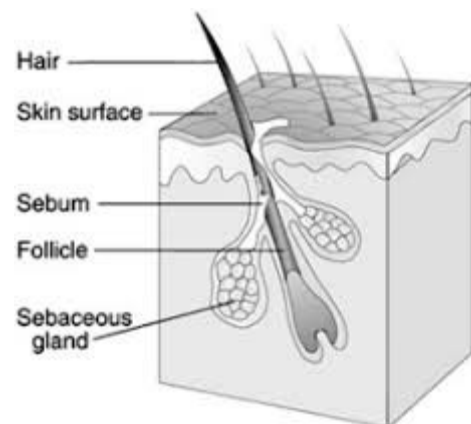
- Are essentially **appendages of hair**; hence, they are found in all areas where hair is present.

Most numerous on the:

- Face
- Forehead
- Scalp

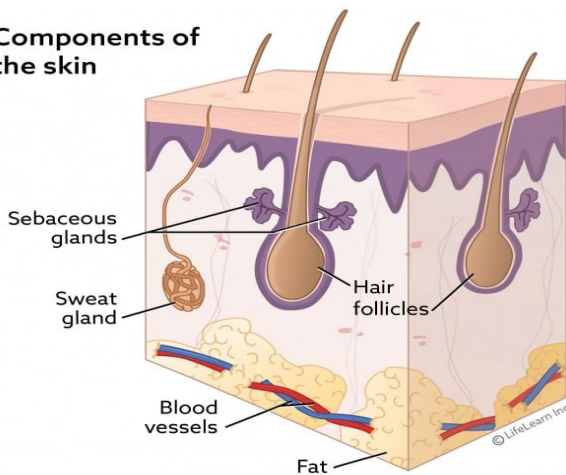
Where during puberty, they become more active and give rise to acne and pimples.

- Are **simple, branched alveolar glands** that are embedded in the dermis and occasionally also in the hypodermis.
- They are **holocrine glands** and it means that their secretory products consist not only of the secretion of cells but also of the cells that produce these secretions.
- In routine histologic preparations, the acinus of a sebaceous gland is seen as consisting of a single layer of flattened or cuboidal peripherally-located cells (**basal cells**) that rest on a basal lamina and surround a central mass of larger, paler-staining, fat droplet-containing cells which are at various stages of differentiation. **Basal cells** have a spherical nucleus, the usual complement of organelles, and some fat droplets.
- The typical sebaceous gland has a short duct lined by **stratified squamous epithelium** that is continuous with **external root sheet** of the hair follicle.



- The secretory product of sebaceous gland is called **sebum**. It is produced in the alveoli acini of the gland.
- As differentiating cells mature, they become larger, paler-staining and accumulate more fat droplets.
- At the same time, they get pushed into the central portion of the acinus by younger cells. The cells degenerate and their nuclei become pyknotic.
- When the cells die, their cell membranes disintegrate releasing their fat droplets. The fat droplets and the remnants of the cells that produce them constitute **sebum**.
- **Sebum** lubricates hair and possibly maintains the soft texture of skin, but it hardly plays a role in preventing fluid loss.

Components of the skin



Sweat Glands

The skin has two (2) types of sweat glands:

1. **Ecrrine**
2. **Apocrine**

Other modified sweat glands in the body:

- **Glands of Moll** – in the eyelids whose secretions are released into the follicles of the eyelashes.
- **Glands of Zeis** – the usual sites for styes.
- **Ceruminous Glands** – of the external auditory canal which produce cerumen.
- **Mammary Glands** – which secrete milk.

Ecrrine Sweat Glands

Are widely distributed in the skin all over the body but are most numerous on **palms** and **soles**.

The only skins they are absent are:

- Margins of the lips
- Concha of the external ear
- Nipple
- Labia minora
- Glans
- Prepuce of the penis

- The sweat gland is a **simple coiled tubular gland**. Its duct is lined by **stratified cuboidal epithelium**.

- The opening of its duct on the skin surface is called **sweat pore**.

- Its secretory portion, which has a slightly bigger diameter than its duct, is embedded deep in the dermis and the hypodermis.

- Consist of a pseudostratified low columnar epithelium that in routine histologic preparations is seen to contain three types of cells:

Light and dark cells are secretory cells.

1. **Light cells** – which rest on a basal lamina, are broad on their luminal portion but tapering towards the basal lamina. They secrete water and electrolytes and are responsible for most of the watery component of sweat.
2. **Dark cells** – are broad at their bases and narrow at their luminal portions. They contain dense, glycoprotein-containing secretory granules in their cytoplasm that are responsible for the dark appearance of the cells.
 - As a rule, the bases of the dark cells do not rest on the basal lamina.

The light and dark cells are distinguishable if special stains such as PAS are used.

3. **Myoepithelial cells** – which are morphologically similar to those present in other exocrine glands are located between the secretory cells and the basal lamina.

- Sweat glands are **merocrine glands** whose primary function is to help regulate body temperature.

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- They do this by producing a clear fluid called **sweat** that evaporates on, and cools, the skin surfaces.
- **Sweat** also serves as a vehicle for excreting some waste materials and products from the body.

Apocrine Sweat Glands

Are found only in the:

- Axilla
 - Around the anus
 - Areola of the breast
 - Labia majora
- They are also **coiled tubular glands** but are much larger (secretory portion = 3 to 5 mm in diameter) than the eccrine sweat glands (0.4 mm in diameter).
 - They are embedded deep in the dermis and subcutaneous tissue.
 - The acini of apocrine sweat glands consist of cuboidal or low columnar cells, which like in eccrine sweat glands, have associated myoepithelial cells.
 - Unlike eccrine sweat glands, apocrine sweat glands only become functional at puberty.

They are called apocrine sweat glands because it was once thought that the secretory cells lose their apical cytoplasm into their secretion.

More recent findings, however, have established that they are actually also **merocrine glands**.

- **Apocrine sweat glands** play a minor role in temperature regulation because of their limited number.
- Their secretion which is more viscous than that of eccrine sweat glands, is sterile and odourless per se, but bacterial action on the secretion produces an unpleasant odor.