The Integumentary System

BY

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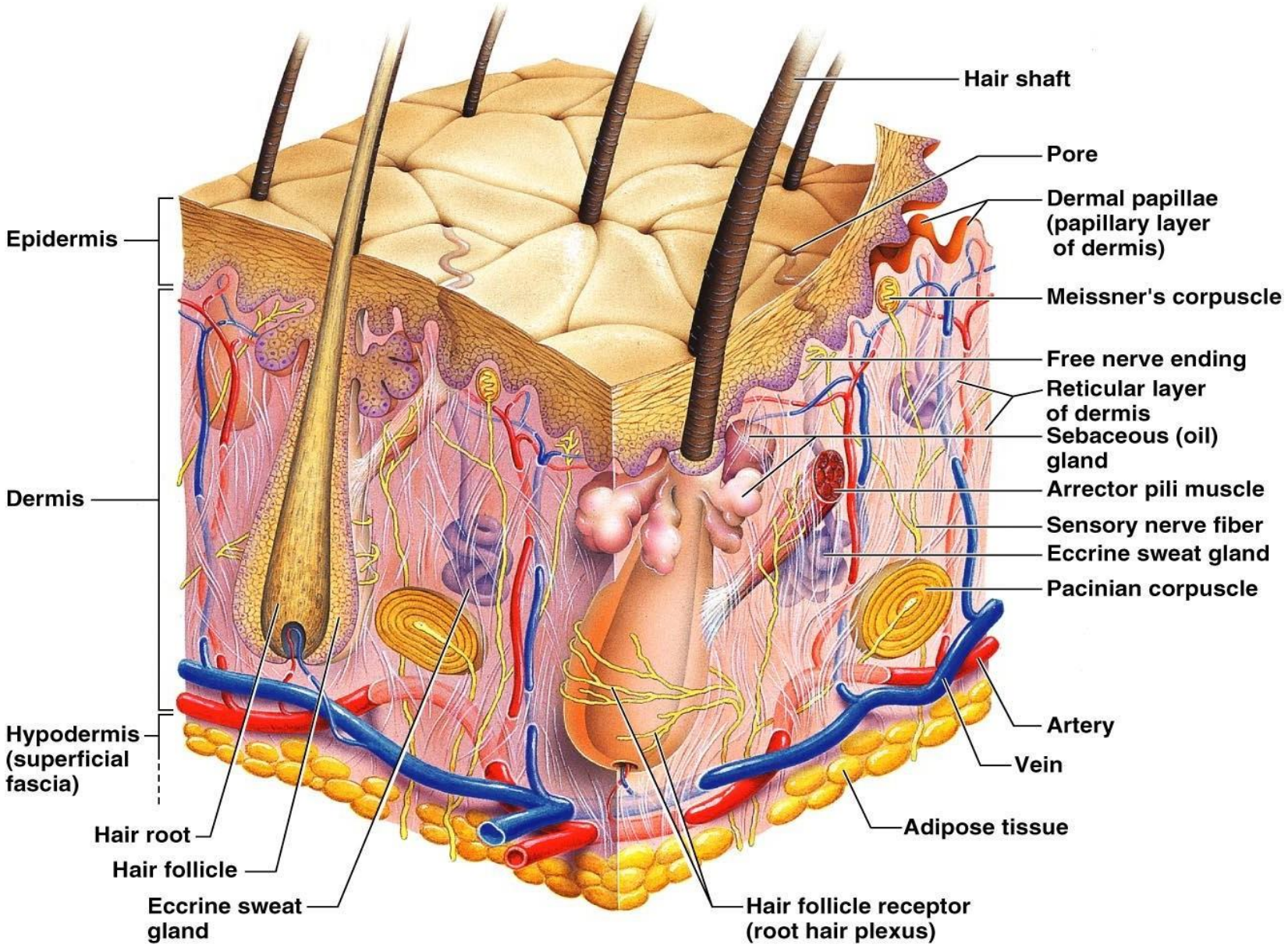
The Skin

The integument system consists of the skin (cutaneous membrane) and its accessory organs.

The skin is composed of three layers of tissue:

- The outer epidermis (made of stratified squamous epithelium), the
- The middle dermis (made of fibrous connective tissue), and
- The inner subcutaneous layer or hypodermis (made of adipose tissue and loose connective tissue).

- **Accessory organs include:**
- the hair (hair root and hair shaft) ,
- hair follicle
- pili arrector muscle
- sebaceous gland
- sudoriferous gland
- nails and
- mammary gland.


Hair shaft
Pore
Dermal papillae (papillary layer of dermis)
Meissner's corpuscle
Free nerve ending
Reticular layer of dermis
Sebaceous (oil) gland
Arrector pili muscle
Sensory nerve fiber
Eccrine sweat gland
Pacinian corpuscle
Artery
Vein
Adipose tissue
Hair follicle receptor (root hair plexus)
Epidermis
Dermis
Hypodermis (superficial fascia)
Hair root
Hair follicle
Eccrine sweat gland

Functions of the Integumentary system

1. protection

a) chemical factors in the skin:

Sebum (or oil) from the sebaceous glands is slightly acidic, retarding bacterial colonization on the skin surface.

Sweat from the sudoriferous glands is slightly hypertonic and can flush off most bacteria on the skin surface.

Melanin (skin pigment) from melonocytes avoids excessive ultraviolet radiation from penetrating the skin layers .

b) physical factors in the skin:

Stratified squamous epithelium in the epidermis layer provides a large number of layers of cells, preventing most bacteria invasion.

Keratinized cells in the stratum corneum layer of the epidermis provides a physical barrier against most invasion.

c) biological factor in the skin:

White blood cells such as **macrophages** destroy most invaded bacteria and other foreign substances.

3. Body temperature regulation

Sweating by the sweat glands promotes evaporation , resulting in a loss of excessive body heat.

Vasoconstriction by arterioles (small arteries) in the dermis layer provides a smaller surface area in the blood vessels, resulting in less heat loss .

Vasodilatation by arterioles in the dermis layer provides a larger surface area in the blood vessels , resulting in greater heat loss .

4. Cutaneous sensation

Nerve receptors in the dermis layers detect sensations such as heat, cold, pain, pressure, and touch, allowing the body to be aware of these stimuli.

5. Vitamin D synthesis

Ultraviolet radiation in the sunlight activates a series of chemical reactions in the epidermis layer, resulting in the synthesis of vitamin D

Functions of the skin

- maintains homeostasis.
- prevents the body from the penetration of harmful substances.
- Prevents water loss.
- help to regulate body temperature .
- contains nerve receptors for various sensations .

Functions of the skin

- synthesizes chemical substances such as keratin, melanin, and vitamin D.
- excretes waste materials such as ammonia , urea , and salts.
- produces skin pigment (melanin) in the epidermis and hair to avoid excessive penetration of UV radiation .

Structure of the skin

There are 3 layers of skin

The Epidermis

Epithelial tissue

Dermis

Dense connective tissue

Hypodermis

Subcutaneous tissue- loose connective tissue proper and adipose tissue

Structure of the skin

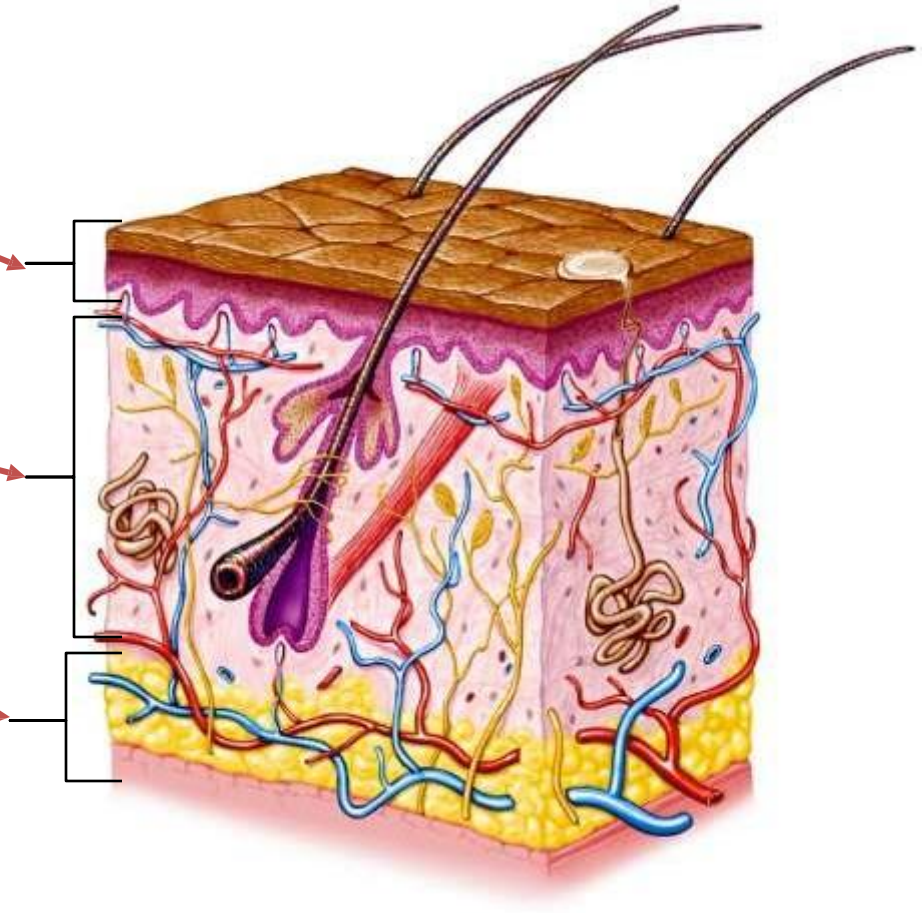
Epidermis

Dermis

Hypodermis

or

***subcutaneous* layer**



Skin Structure : Epidermis

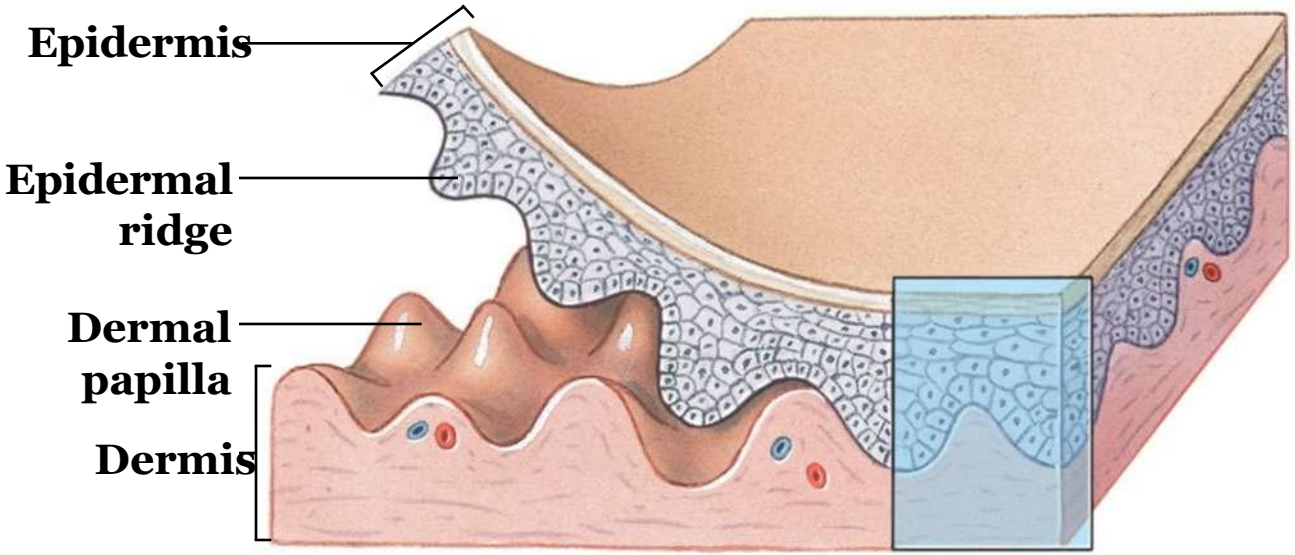
The Epidermis

- Is a vascular stratified squamous epithelium
- Nutrients and oxygen diffuse from capillaries in the dermis
- Cells of the Epidermis

Keratinocytes

- Contain large amounts of keratin
- Are the most abundant cells in the epidermis

Skin Structure : Epidermis



Skin Structure : Epidermis

Thin Skin

- Covers most of the body
- Has four layers of keratinocytes

Thick Skin

- Covers the palms of the hands and soles of the feet
- Has five layers of keratinocytes

Skin Structure : Epidermis

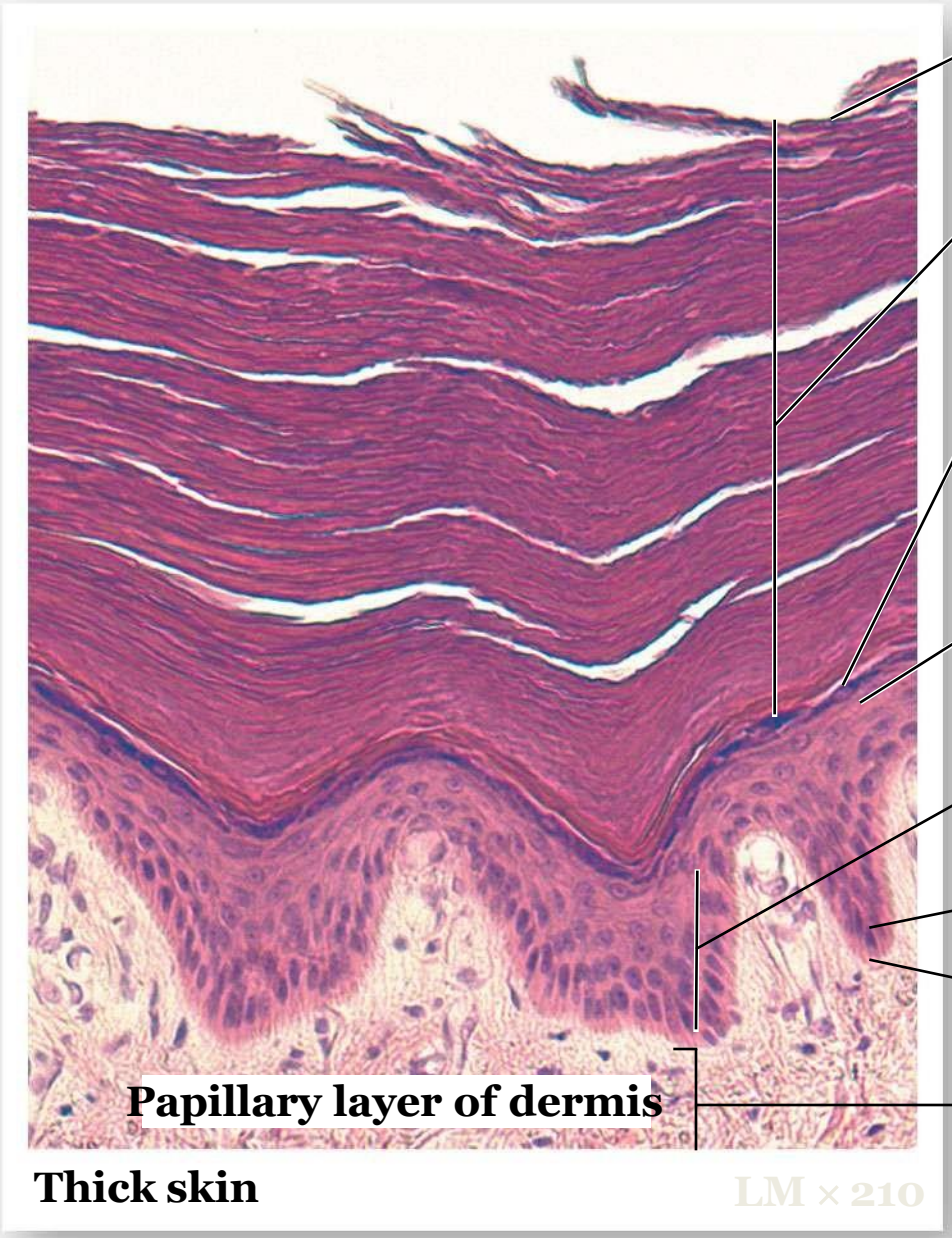
Structures of the Epidermis

The five *strata* of keratinocytes in thick skin

From basal lamina to free surface

1. **Stratum basale**
2. **Stratum spinosum**
3. **Stratum granulosum**
4. **Stratum lucidum**
5. **Stratum corneum**

EPIDERMIS

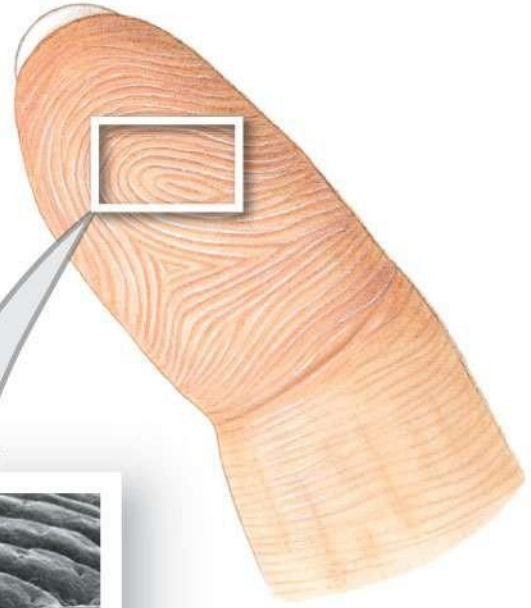

Surface
Stratum corneum
Stratum lucidum
Stratum granulosum
Stratum spinosum
Stratum basale
Basement membrane
Dermis
Papillary layer of dermis
Thick skin
LM × 210

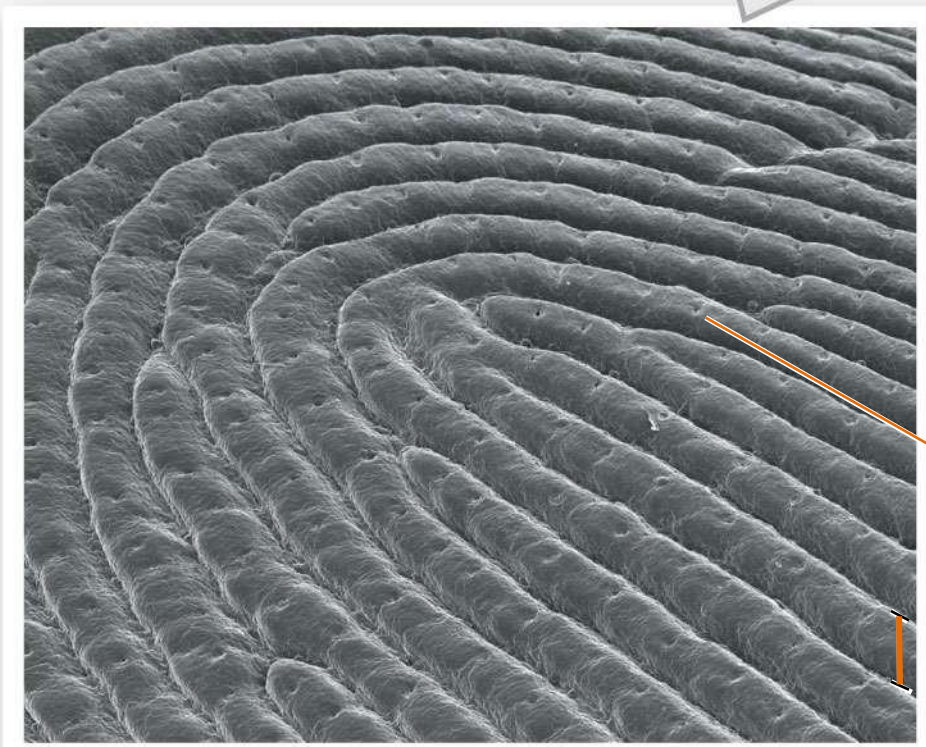
Skin Structure : Epidermis

Stratum Basale

- Forms a strong bond between epidermis and dermis
- Forms **epidermal ridges** (e.g., fingerprints)
- **Dermal papillae** (tiny mounds)
  - Increase the area of basement membrane
  - Strengthen attachment between epidermis and dermis
- Has many **basal cells**

Epidermal ridges





Thick skin

SEM × 25

Pores of sweat gland ducts

Epidermal ridge

Skin Structure : Epidermis

Stratum Spinosum — the –spiny layer‖

- Produced by division of stratum basale
- Eight to ten layers of keratinocytes bound by desmosomes
- Continue to divide, increasing thickness of epithelium
- Contain dendritic (Langerhans) cells, active in immune response

Skin Structure : Epidermis

Stratum Granulosum — the –grainy layer‖

Stops dividing, starts producing

- **Keratin**
  - A tough, fibrous protein
  - Makes up hair and nails
- **Keratohyalin**
  - Dense granules
  - Cross-link keratin fibers

Skin Structure : Epidermis

Stratum Lucidum — the —clear layer

- Found only in thick skin
- Covers stratum granulosum

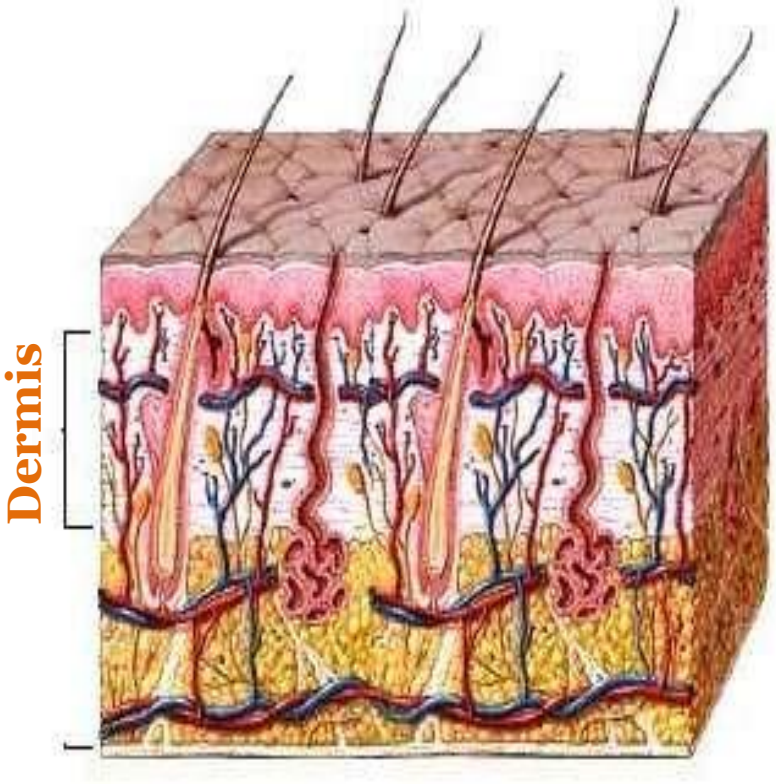
Stratum Corneum — the —horn layer‖

- Exposed surface of skin
- Water resistant
- Shed and replaced every 2 weeks

Skin Structure : Dermis

Two components

1. Outer **papillary layer**
2. Deep **reticular layer**



Skin Structure : Dermis

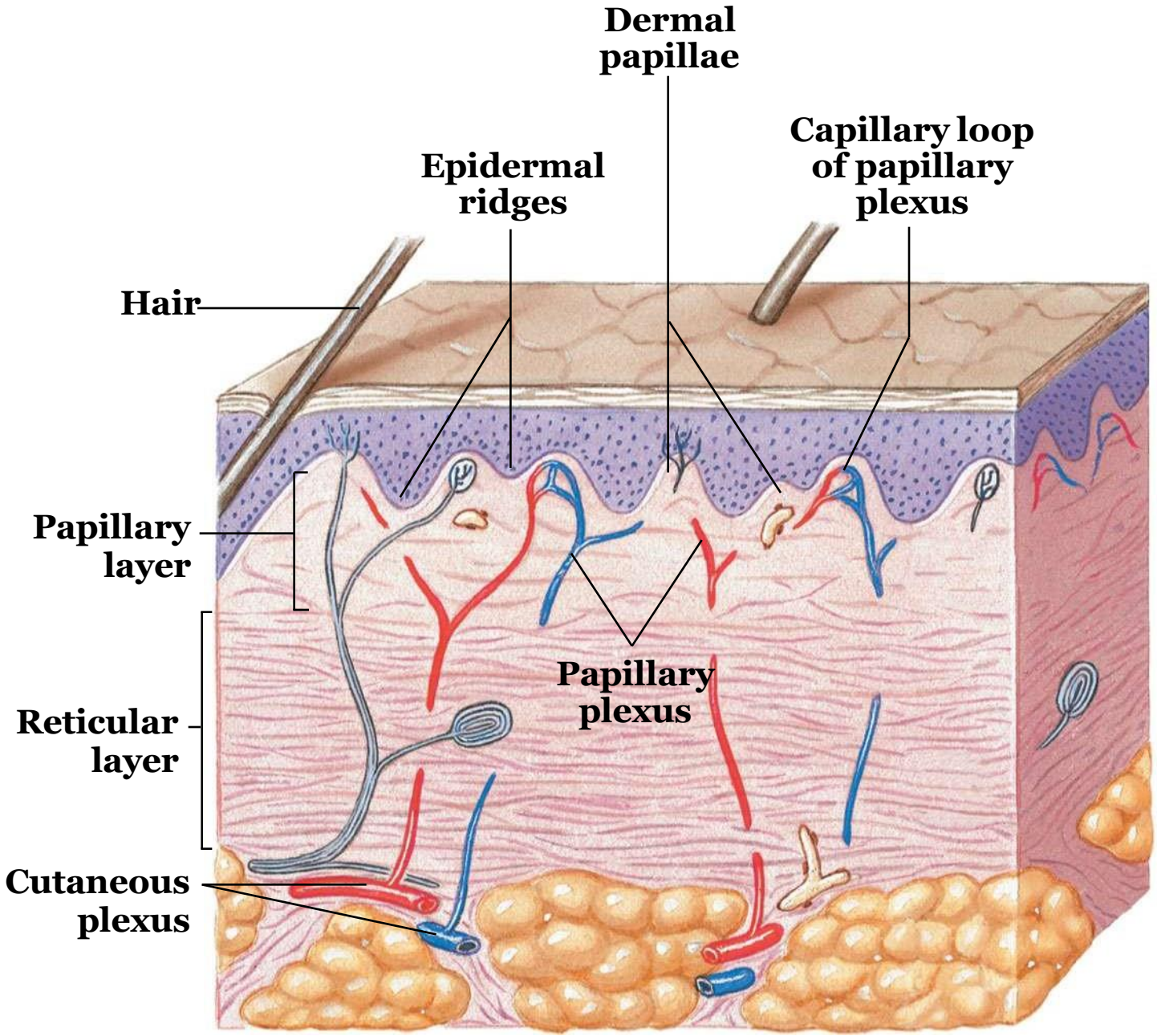
The **Papillary Layer**

- Consists of areolar tissue
- Contains smaller capillaries, lymphatics, and sensory neurons
- Has dermal papillae projecting between epidermal ridges

The **Reticular Layer**

- Consists of dense irregular connective tissue
- Contains larger blood vessels, lymphatic vessels, and nerve fibers
- Contains collagen and elastic fibers

DERMIS

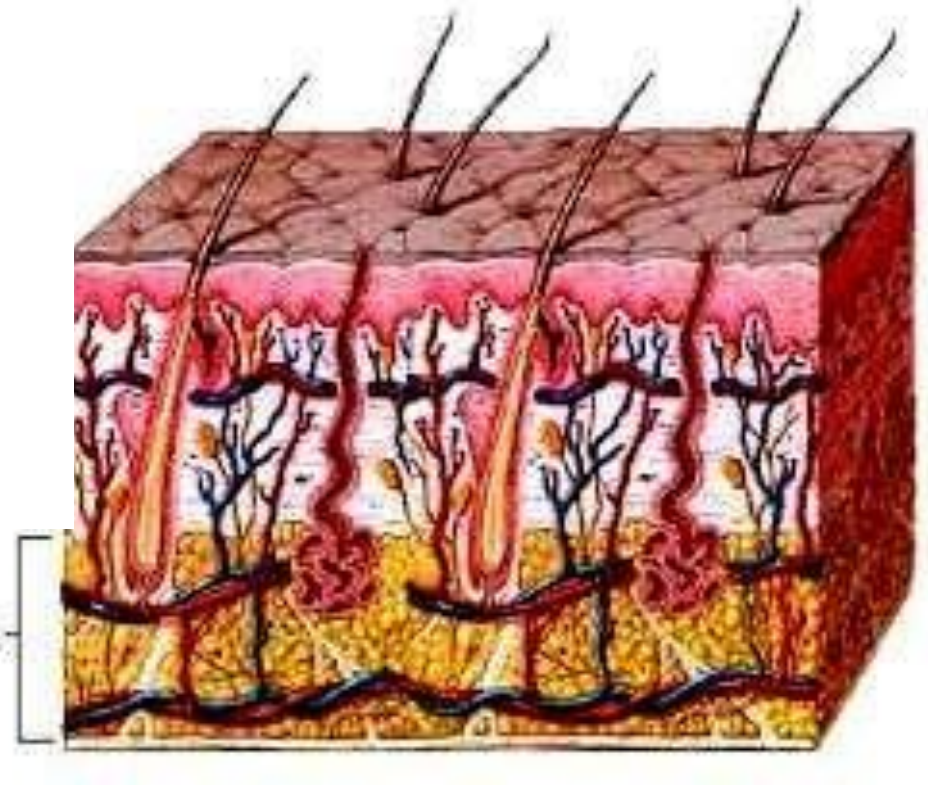

Dermal papillae
Epidermal ridges
Capillary loop of papillary plexus
Hair
Papillary layer
Papillary plexus
Reticular layer
Cutaneous plexus

Skin Structure : Hypodermis

The **Hypodermis** (Subcutaneous Layer)

- Lies below the integument
- Stabilizes the skin
- Made of elastic areolar and adipose tissues
- Connected to the reticular layer of integument by connective tissue fibers
- Deposits of Subcutaneous Fat

Skin Structure : Hypodermis



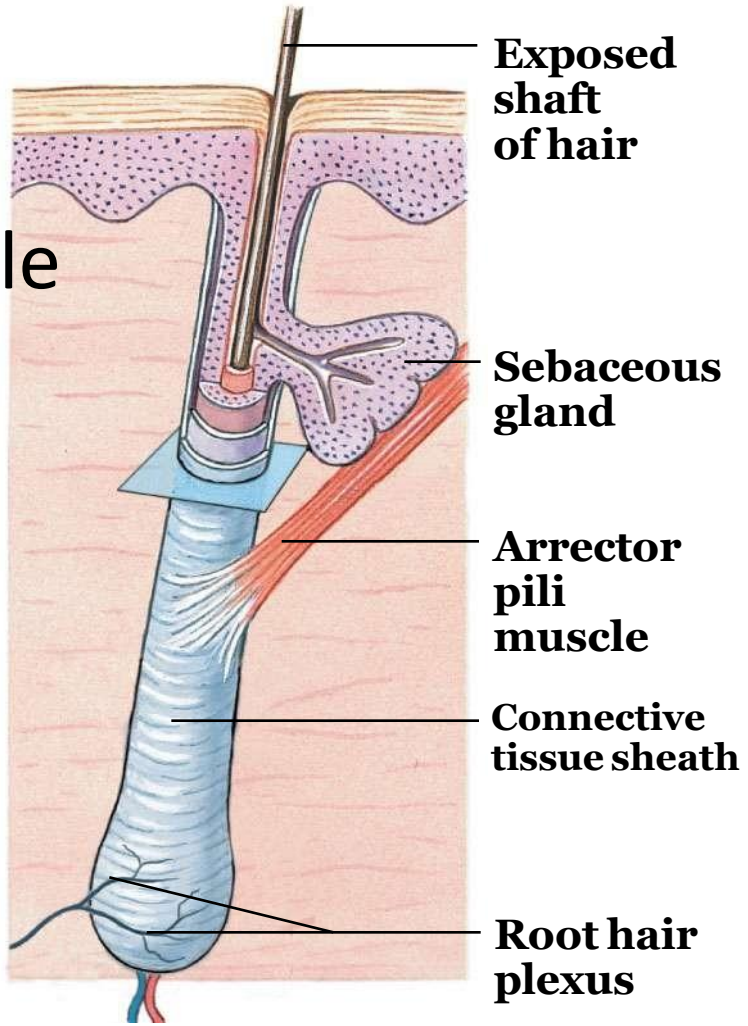
Structure of Hair

The **Hair Follicle**

- Hair follicles are the organs that form the hairs.
- Located deep in dermis.
- Produces nonliving hairs.
- Wrapped in a dense connective tissue sheath.
- Base is surrounded by sensory nerves
- Control bacteria

Structure of Hair

- Accessory Structures of Hair
  - **Arrector pili**
  - Involuntary smooth muscle
  - Causes hairs to stand up
  - Produces —goose bumps
  - Sebaceous glands
  - Lubricate the hair



Structure of Hair

Regions of the Hair

Hair root

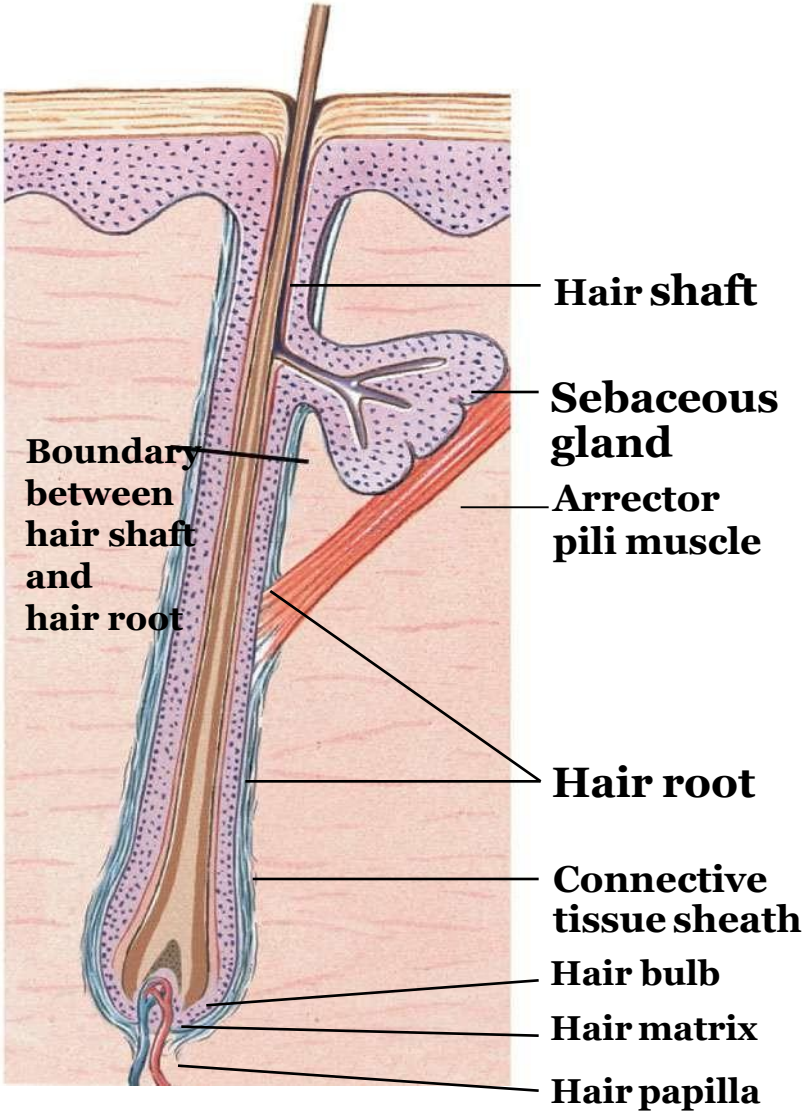
Lower part of the hair

Attached to the integument

Hair shaft

Upper part of the hair

Not attached to the integument



Structure of Hair

Hair Shaft Structure

- **Medulla**
  - Core, dead cells contain soft keratin and air to provide flexible
- **Cortex**
  - Middle layer, dead cells contain hard keratin to provide stiffness
- **Cuticle**
  - Outermost, overlapping dead keratinized cells form shiny surface

Function of Hair

Head:

- UV protection
- Cushion from trauma
- Insulation

Nostrils, Ear canals, Eyelashes:

- Prevent entry of foreign material

Body Hair:

- sensory detection

Root hair plexus:

- Sensory nerves at base of hair follicle that detect slight movement of hair

Arrector pili muscle:

- Attached to every hair follicle
- Contract to stand hair perpendicular to skin surface

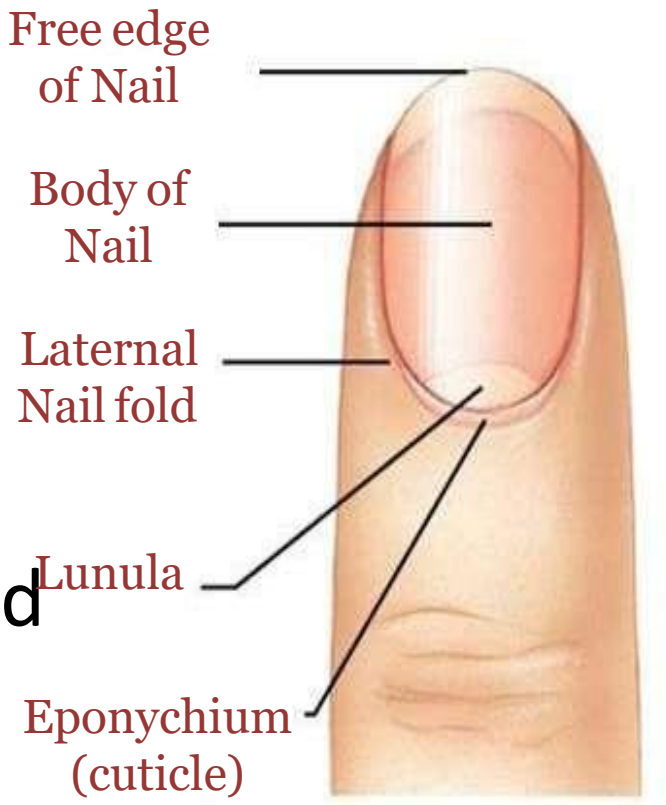
Structure and function of Nail

Nails

- Protect fingers and toes
- Made of dead cells packed with keratin
- Metabolic disorders can change nail structure

Nail Production

- Occurs in a deep epidermal fold near the bone called the **nail root**

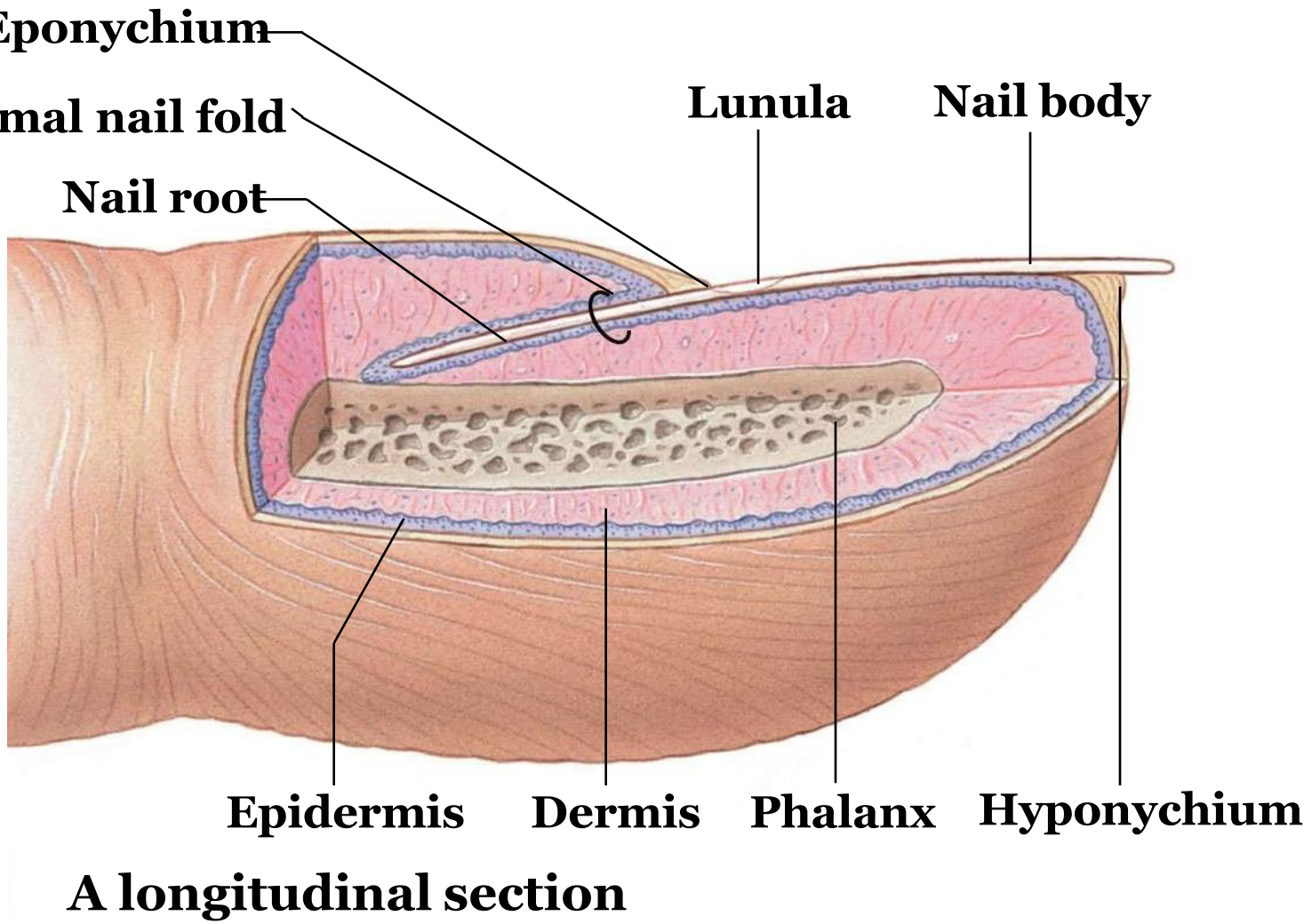


Structure and function of Nail

Structure of a Nail

- **Nail body**
  - The visible portion of the nail
  - Covers the **nail bed**
- **Lunula**
  - The pale crescent at the base of the nail
- Sides of nails
  - Lie in **lateral nail grooves**
  - Surrounded by **lateral nail folds**

Structure and function of Nail



A longitudinal section