

5

The Integumentary System



Integumentary Structure & Function

Integumentary System Components

Cutaneous membrane

Epidermis(skin)

Dermis

Accessory structures(hair, nails, glands)

Subcutaneous layer (*hypodermis*)

The hypodermis attaches the integument to deeper structures such as muscles and bones

Main Functions of the Integument

5 Major Functions:

Protection- physical barrier

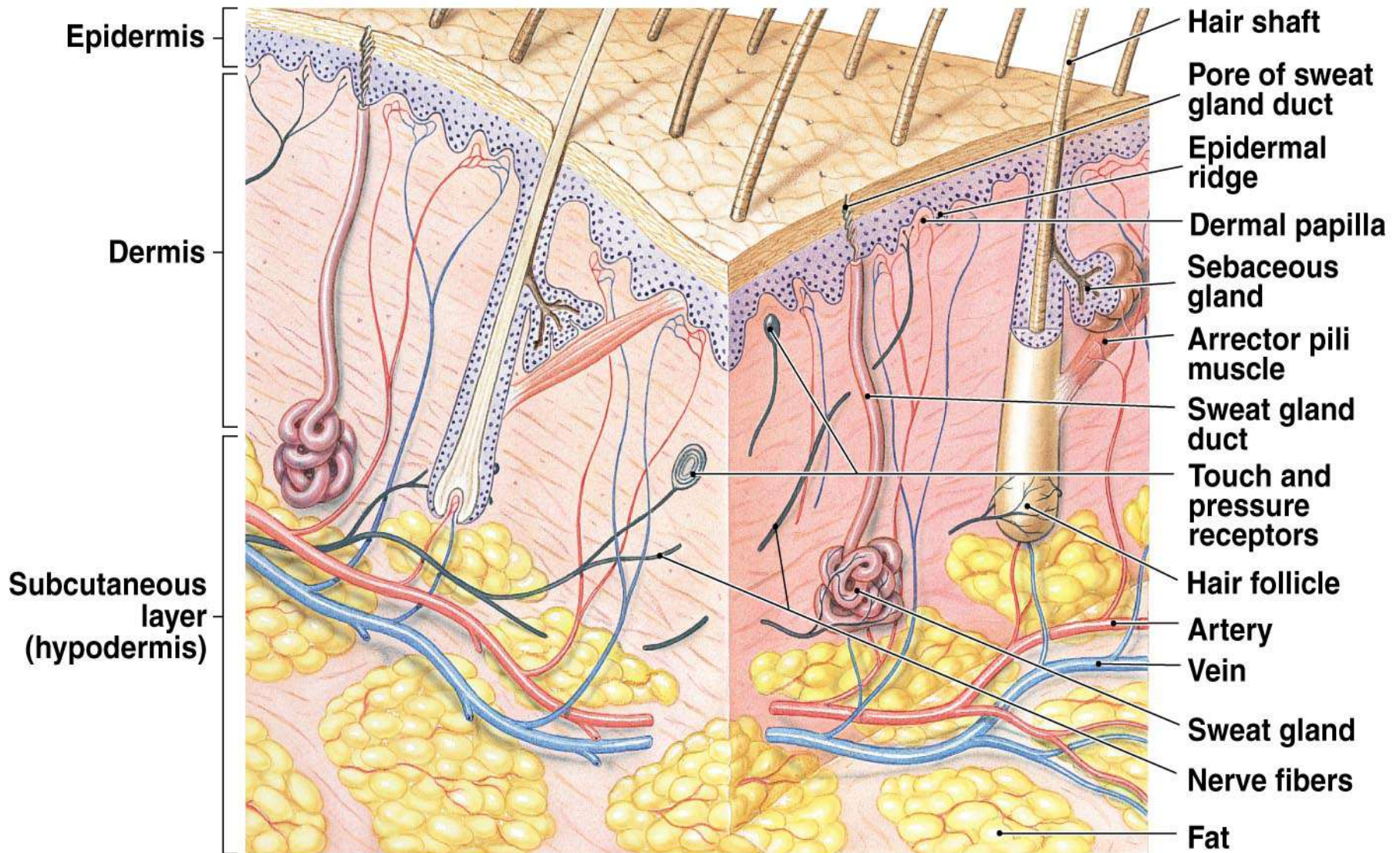
Temperature Maintenance- regulates heat exchange with the environment

Synthesis & Storage of Nutrients- makes vitamin D₃, stores lipids

Sensory Reception- detects touch, pain, temperature via receptors in the skin

Excretion and Secretion- excretes water, salt and organic wastes

Components of the Integumentary System



The Epidermis

- Stratified squamous epithelium

Several distinct cell layers:

Thick Skin- five layers, thick as a paper towel

On palms and soles

Thin Skin- four layers, thick as a plastic bag

On rest of body

Layers of The Epidermis

Stratum germinativum

Stratum spinosum

Stratum granulosum

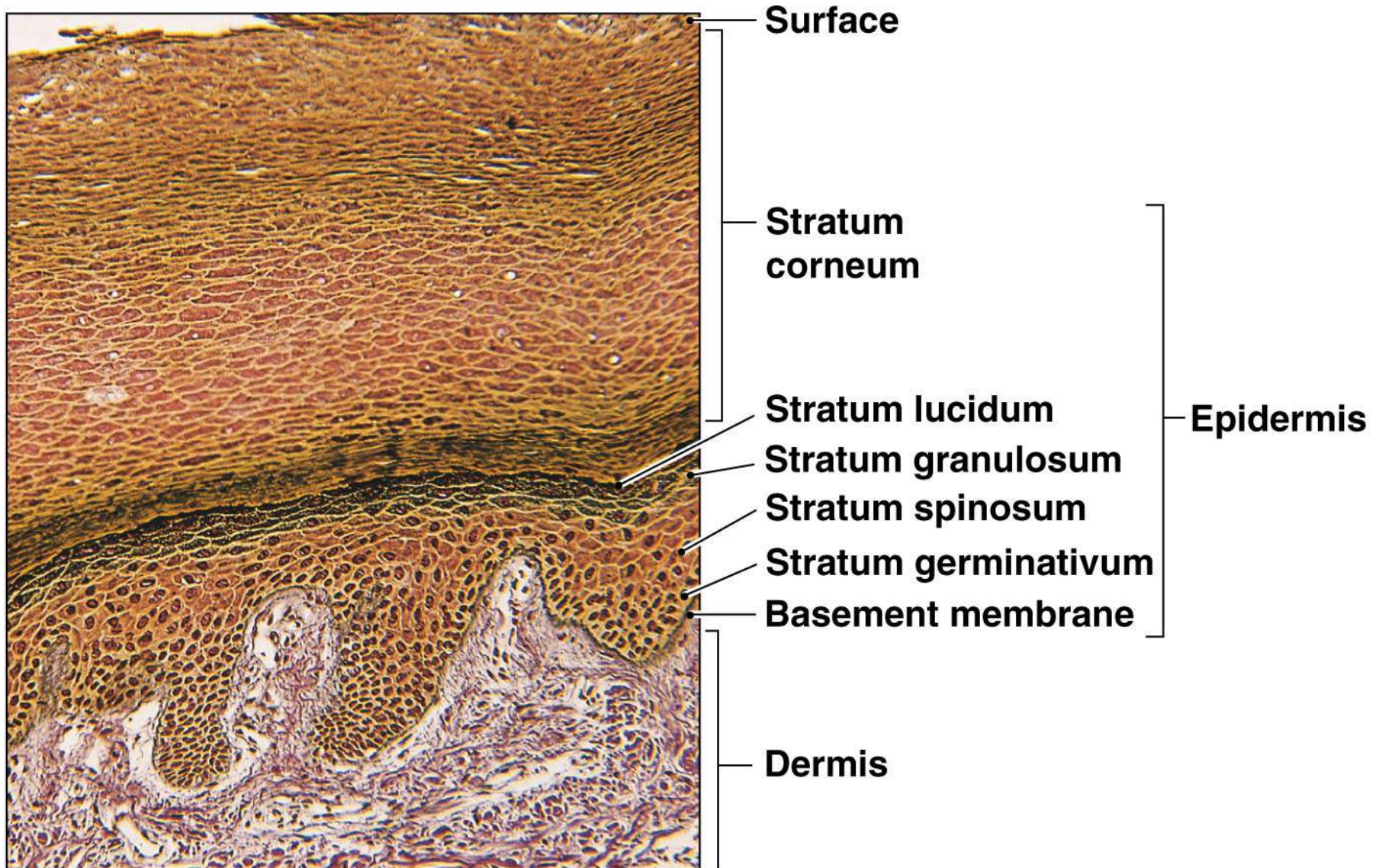
Stratum lucidum (in thick skin)

Stratum corneum

Dying superficial layer

Keratin accumulation

Structure of the Epidermis



Layers of The Epidermis

Stratum germinativum:

Basal layer(deepest layer)

Is attached to the basement membrane

Contains many Stem Cells

Active cell division layer

Source of replacement cells

Melanocytes

Synthesize *melanin* (skin pigment)

Epidermal Ridges

Contours of skin surface follow deep tissue ridge patterns (finger prints)

Layers of The Epidermis

Intermediate strata:

- consists of 3 layers that are progressively displaced from the basal layer

Stratum spinosum (spiny layer)

Superficial to stratum germinativum

Stratum granulosum (grainy layer)

Cells in this layer begin making large amounts of keratin protein

Keratin: very durable water resistant protein, also found in hair, nails, hooves & horns

Stratum lucidum (clear layer)

Cells in this layer are flattened and filled with keratin

Layers of The Epidermis

Stratum corneum:

Most superficial layer

Consists of 15-30 layers of squamous, dead epithelial cells

Cells in this layer are filled with keratin

Keratinized (also, cornified)

Tough, water-resistant protein

* It takes 2-4 weeks for a cell to move from the *stratum germinativum* to the *stratum corneum*

Skin Color

Sources of Skin Color

Melanocytes

Make *melanin* when exposed to sunlight

Melanin provides UV protection

Gives reddish-brown to brown-black color

Carotene

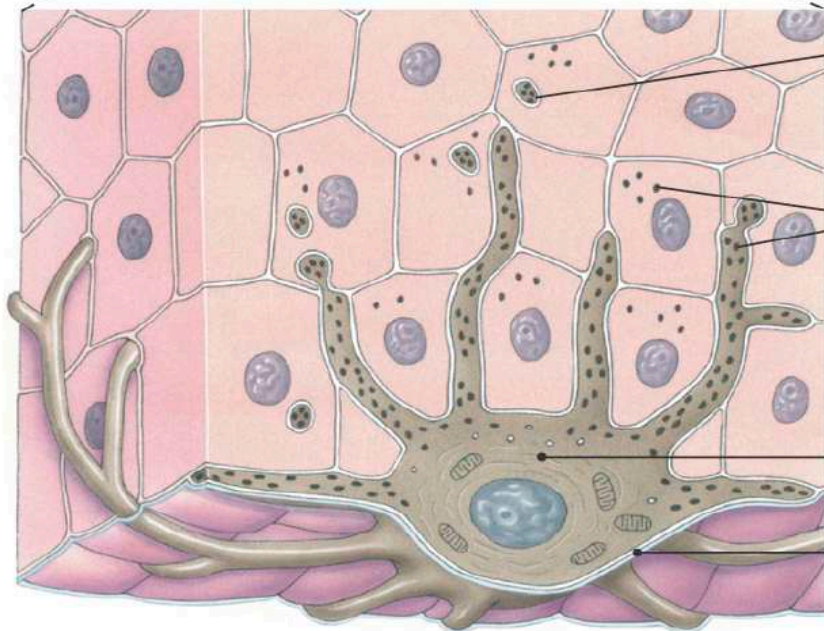
Contributes orange-yellow color

Provided from diet (carrots & squash)

Hemoglobin

Blood pigment affects skin color (blushing)

Melanocytes



Melanin-containing vesicle

Melanin pigment

Melanocyte

Basement membrane

Dermal Circulation

- Blood vessels in the dermis affect redness of skin color
 - Cyanosis: lack of oxygen in the blood supply
 - Makes skin take on a bluish coloration
 - Most apparent in the lips, ears, nails

Effects of UV Radiation

Beneficial Effect:

Activates synthesis of *vitamin D₃*

D₃ is needed for calcium absorption
and bone growth

Harmful Effects:

Sun burn

Wrinkles, premature aging

Malignant melanoma (skin cancer)

Basal cell carcinoma

Two Important Types of Skin Cancer



(a) Basal cell carcinoma



(b) Melanoma

Integumentary Structure/Function

Key Note:

The epidermis is a multi-layered, flexible, self-repairing barrier that prevents fluid loss, provides protection from UV radiation, produces vitamin D₃, and resists damage from abrasion, chemicals, and pathogens

The Dermis

- Lies beneath the epidermis, has 2 main layers

Papillary Layer

Consists of loose connective tissue

Supports, nourishes epidermis

Contains capillaries and nerves
supplying the surface of the skin

Reticular Layer

Made of dense, irregular connective
tissue

Contains elastic fibers and collagen
for flexibility and strength

The Subcutaneous Layer (hypodermis)

Stabilizes position of skin relative to underlying tissues

Consists of loose connective tissue and may contain fat cells

Contains large blood vessels

Often the site of subcutaneous injections via a hypodermic needle

Integumentary Structure/Function

Key Note:

The dermis provides mechanical strength, flexibility, and protection for underlying tissues. It is highly vascular and contains a variety of sensory receptors that provide information about the external environment.

Accessory Structures

Hair and hair follicles

Hair is non-living

Structures:

Papilla- connective tissue containing capillaries and nerves

Hair Root- anchors hair to skin

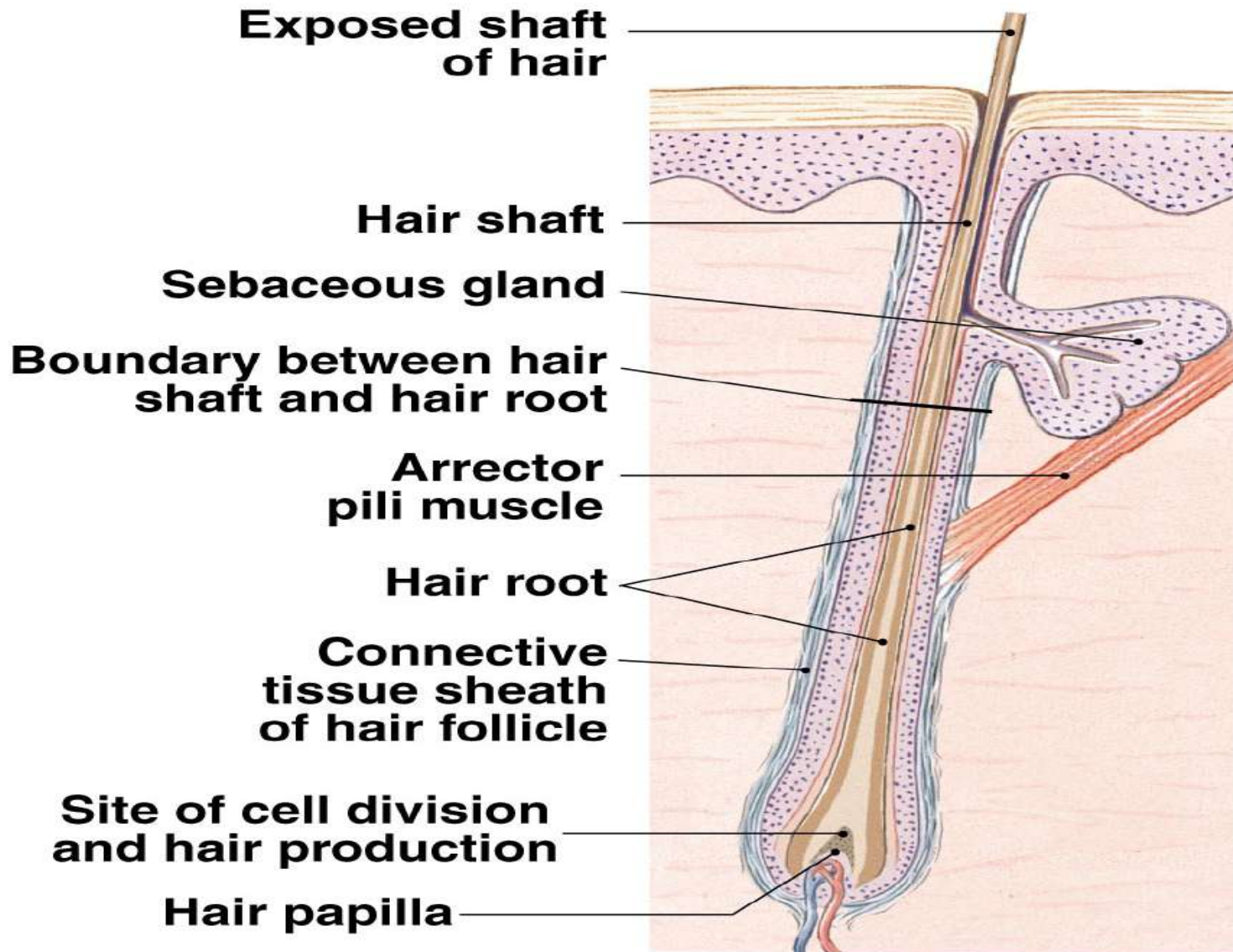
Hair Shaft- has 3 layers

1) cuticle- surface layer (hard)

2) cortex- middle layer

3) medula- core (soft)

Hair Follicles



(b)

Hair Follicles

Epidermis

Hair shaft

Arrector pili muscle

Sebaceous gland

Dermis



Hair (longitudinal section)

Hair follicle (cross section)

Subcutaneous adipose tissue

Site of cell division and hair production

Hair papilla

(a)

Hair Follicles

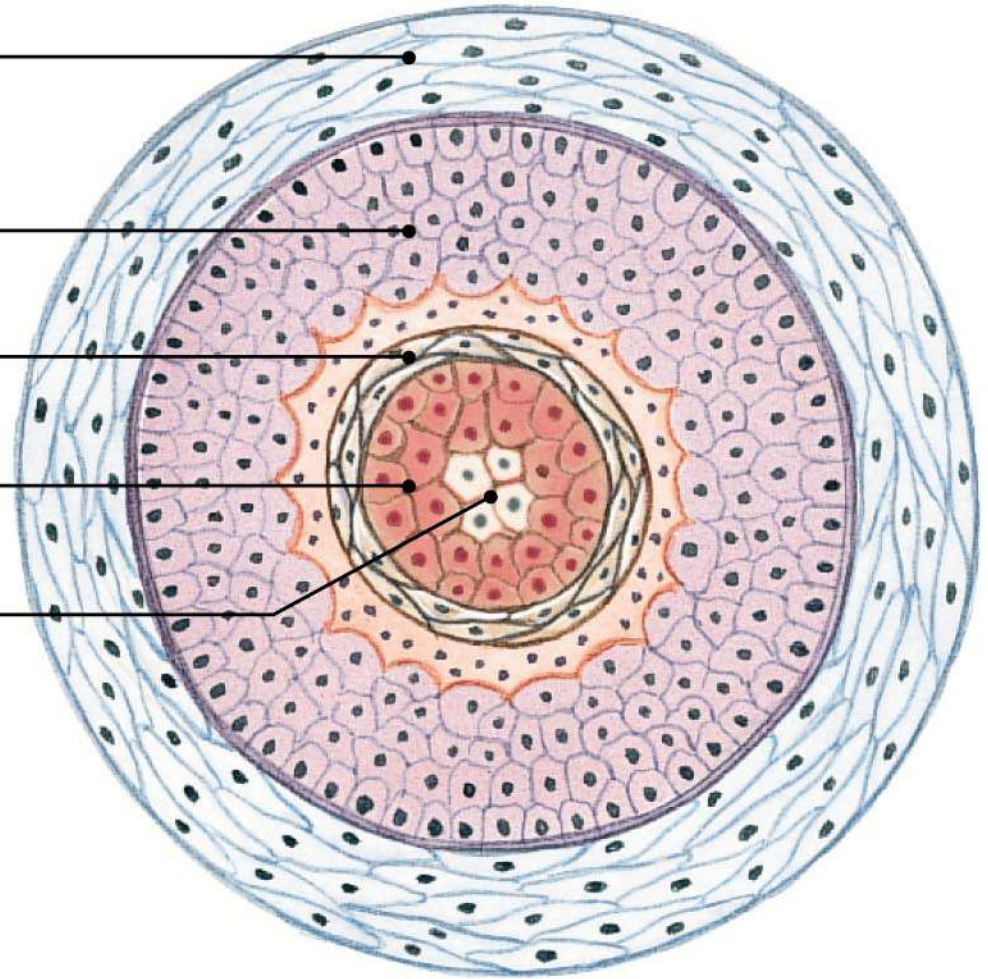
Connective tissue sheath

Wall of hair follicle

Cuticle of hair

Cortex of hair

Medulla of hair



(c)

Functions of Hair

- Provides scalp protection from UV
- Provides insulation
- Traps foreign particles (nose, ear, eye lashes)
- Sensory detection

Arrector Pili- muscles attached to hair root that makes hair “stand up” (goose bumps)

Hair Color- determined by the amount of pigment produced by melanocytes at the hair papilla

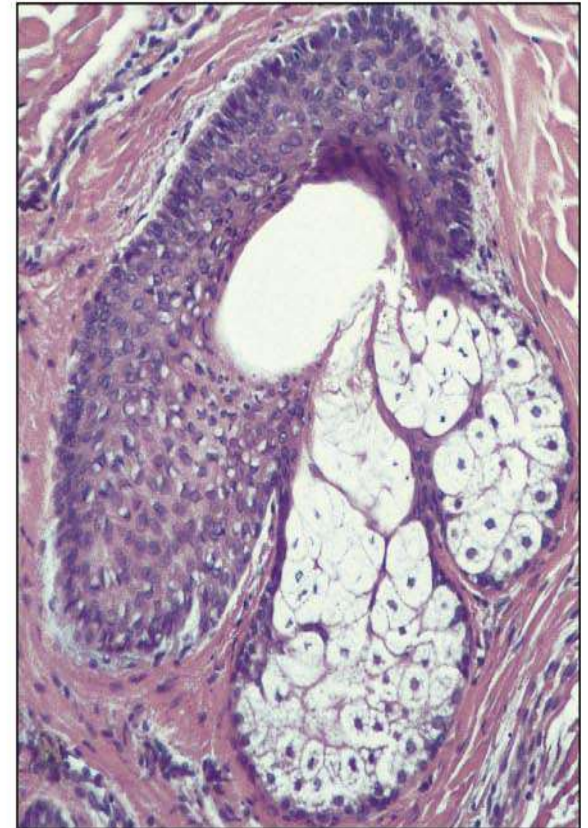
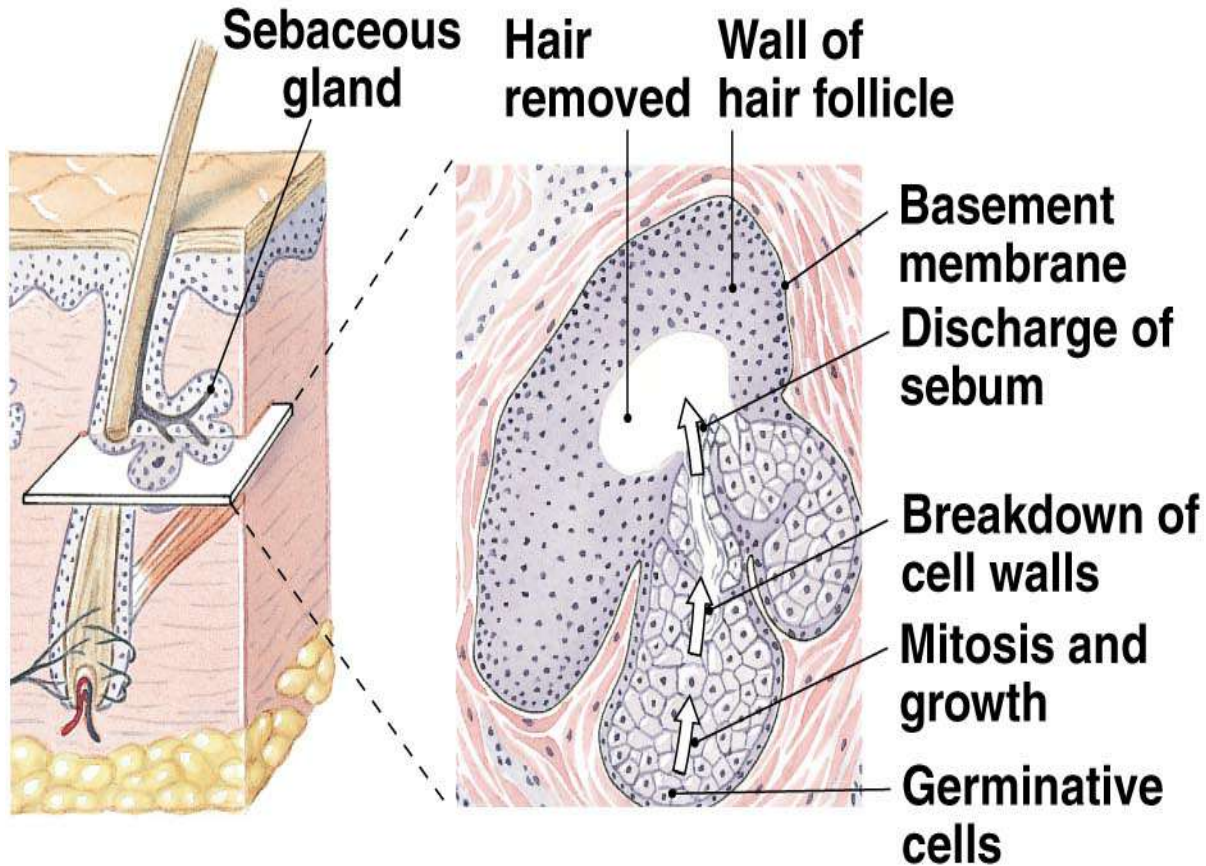
Sebaceous Glands (oil glands)

- secrete oil into hair follicles and onto skin

Sebum- hair shaft lubricant,
prevents bacterial growth

Acne- occurs when sebaceous glands become blocked and secretions accumulate under skin

Structure of Sebaceous Glands



Sebaceous gland

LM × 150

Sweat Glands

Apocrine Sweat Glands

Odorous secretion (“*funky*”)

Absent before puberty

Present in arm pits, areola, groin

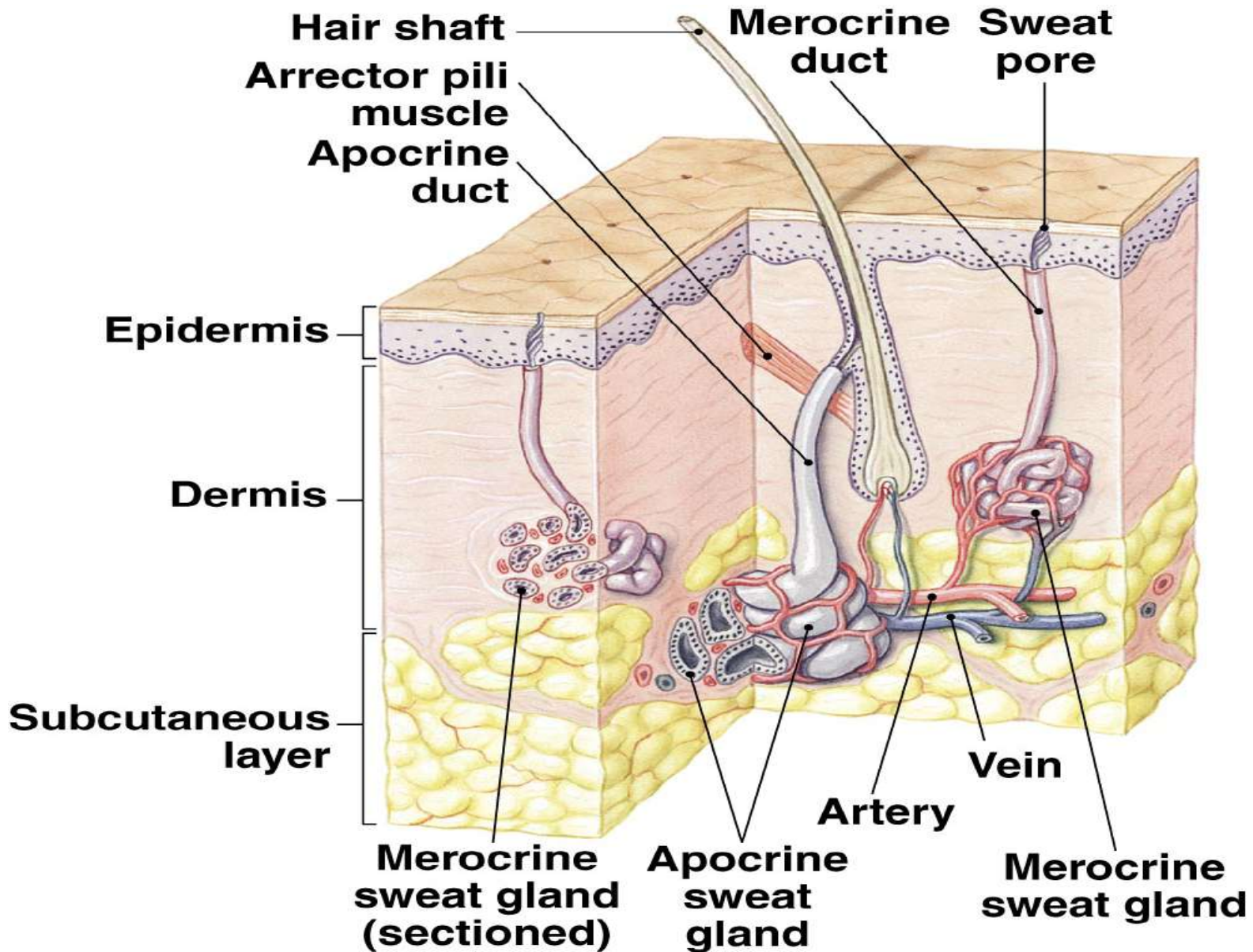
Merocrine Sweat Glands

Secrete watery sweat (~1% NaCl)

For heat loss on skin

Widely present in skin (up to 500/cm²)

Sweat Glands



Integumentary Structure/Function

Key Note:

The skin plays a major role in controlling body temperature. It acts as a radiator, with the heat being delivered by the dermal circulation and removed primarily by the evaporation of sweat or perspiration.

Nails

- Found on fingers and toes
- Protect exposed tips

Nail body- Dense mass of
keratinized cells

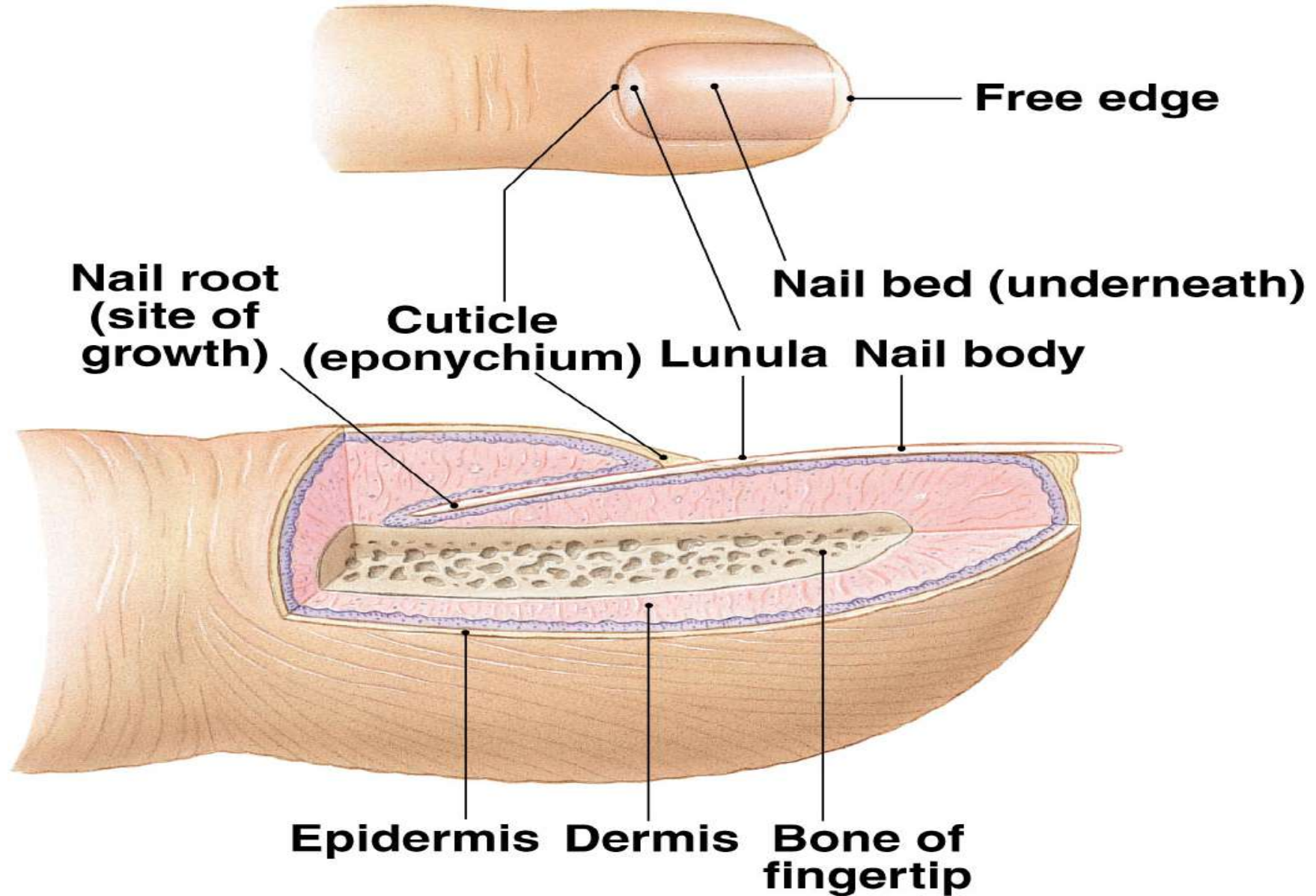
Nail bed- soft tissue under nail

Nail root- site of nail growth

Cuticle- skin growing at base of
nail

Lunula- white portion at base of
nail

The Structure of a Nail



Skin Injury and Repair

Four Stages in Skin Healing

Inflammation

- Blood flow increases
- Phagocytes attracted

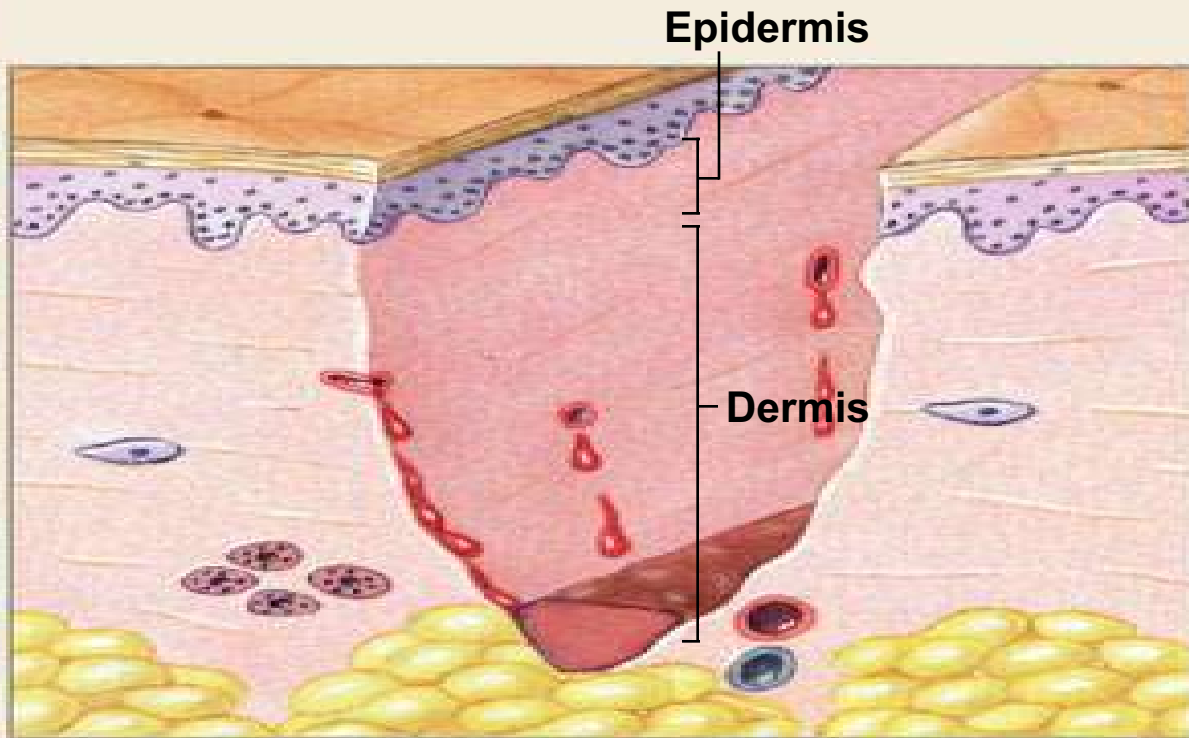
Scab formation

Cell division and migration

Scar formation

STEP 1

Bleeding occurs at the site of injury immediately after the injury, and mast cells in the region trigger an inflammatory response.

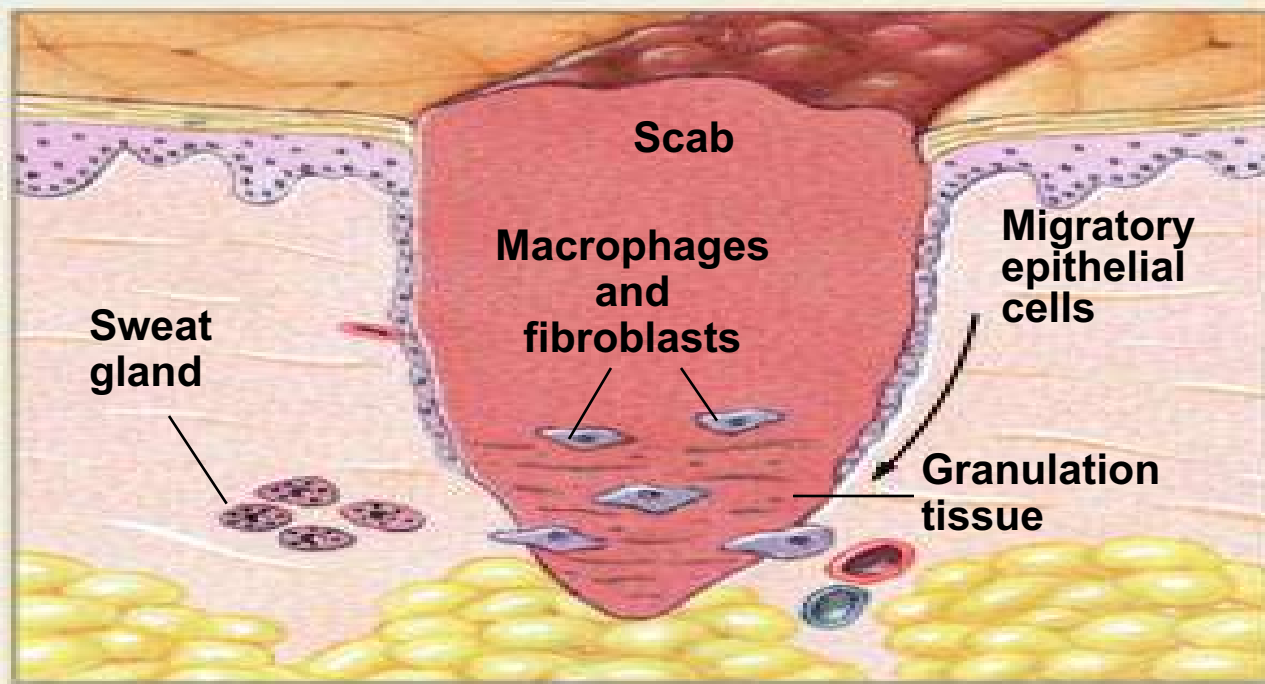


STEP 2

After several hours, a scab has formed and cells of the stratum germinativum are migrating along the edges of the wound.

Phagocytic cells are removing debris, and more of these cells are arriving with the enhanced circulation in the area.

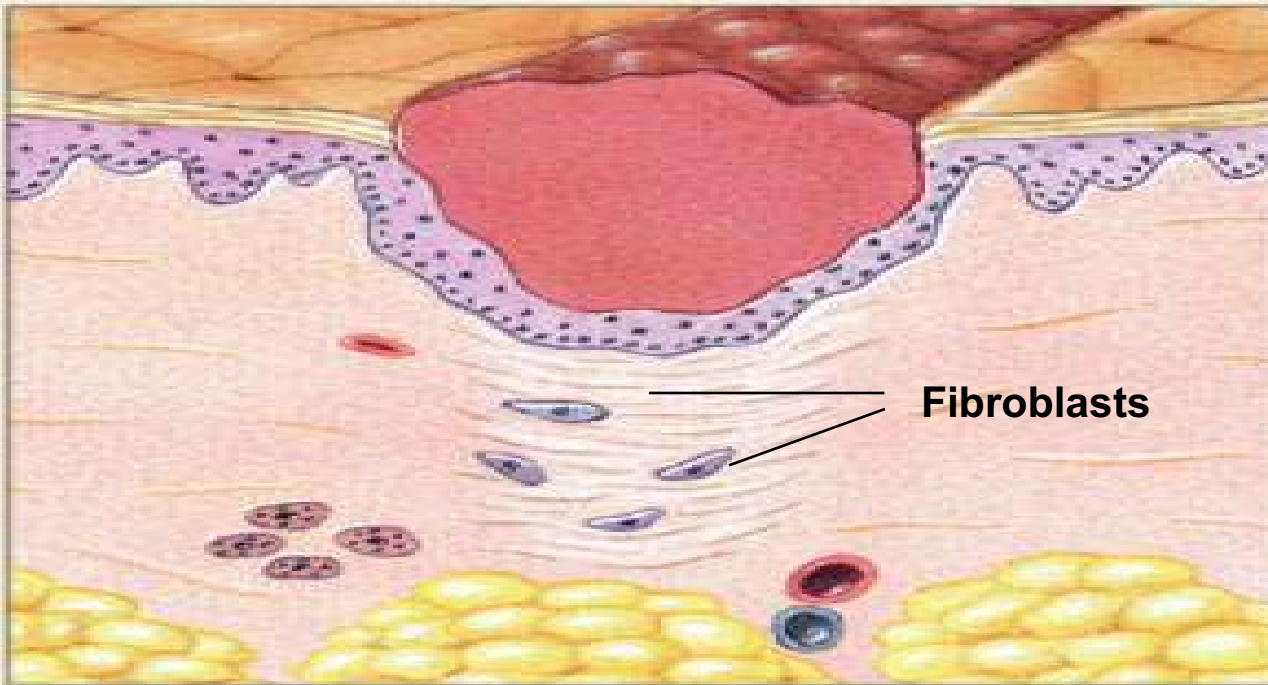
Clotting around the edges of the affected area partially isolates the region.



STEP 3

One week after the injury, the scab has been undermined by epidermal cells migrating over the meshwork produced by fibroblast activity.

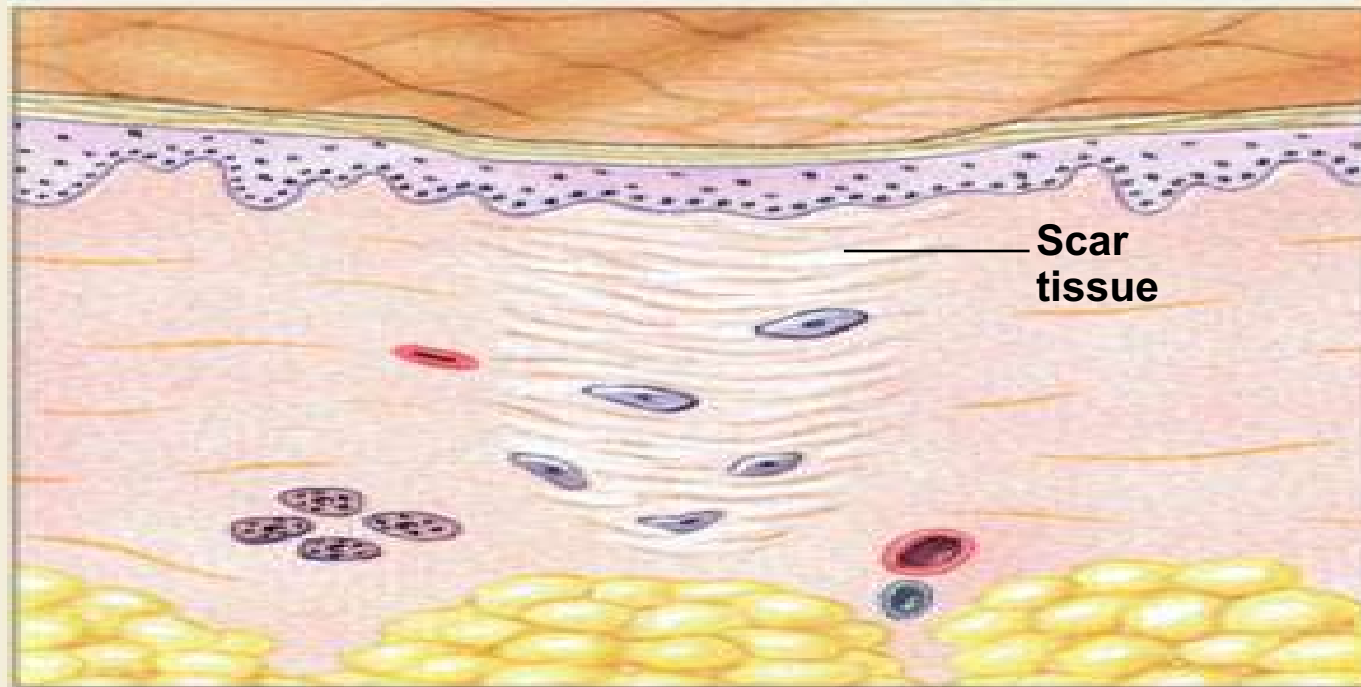
Phagocytic activity around the site has almost ended, and the fibrin clot is disintegrating.



STEP 4

After several weeks, the scab has been shed, and the epidermis is complete.

A shallow depression marks the injury site, but fibroblasts in the dermis continue to create scar tissue that will gradually elevate the overlying epidermis.



Burns

TABLE 5-1 *A Common Classification of Burns*

CLASSIFICATION	DAMAGE REPORT	APPEARANCE AND SENSATION
FIRST-DEGREE BURN	<i>Killed:</i> superficial cells of epidermis <i>Injured:</i> deeper layers of epidermis, papillary dermis	Inflamed; tender
SECOND-DEGREE BURN	<i>Killed:</i> superficial and deeper cells of epidermis; dermis may be affected <i>Injured:</i> damage may extend into reticular layer of the dermis, but many accessory structures are unaffected	Blisters; very painful
THIRD-DEGREE BURN	<i>Killed:</i> all epidermal and dermal cells <i>Injured:</i> hypodermis and deeper tissues and organs	Charred; no sensation at all

Aging of the Skin

Major Age-Related Changes

Injury and infection increase

Immune cells decrease

Sun protection diminishes

Skin becomes dry, scaly

Hair thins, grays

Sagging, wrinkles occur

Heat loss decreases

Repair slows

END OF CHAPTER 5 NOTES!!!