



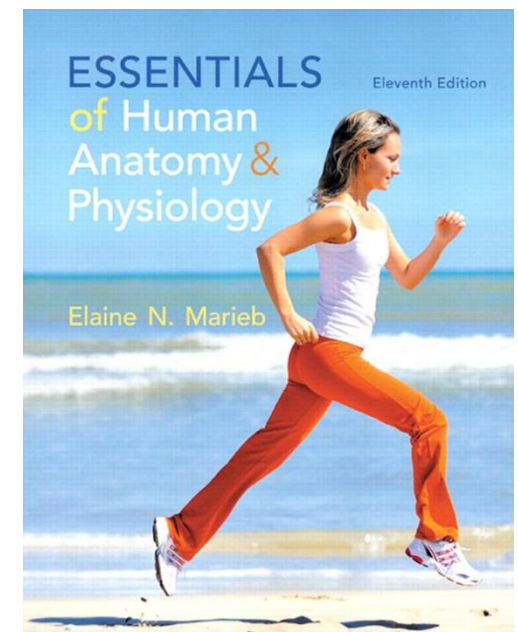
Human Anatomy and Physiology

CLS 224

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Lecture 3:

Skin & Body Membranes (chapter 4)

1. Body membranes.
2. Integumentary system.

1. Classification of body membranes

Objectives:

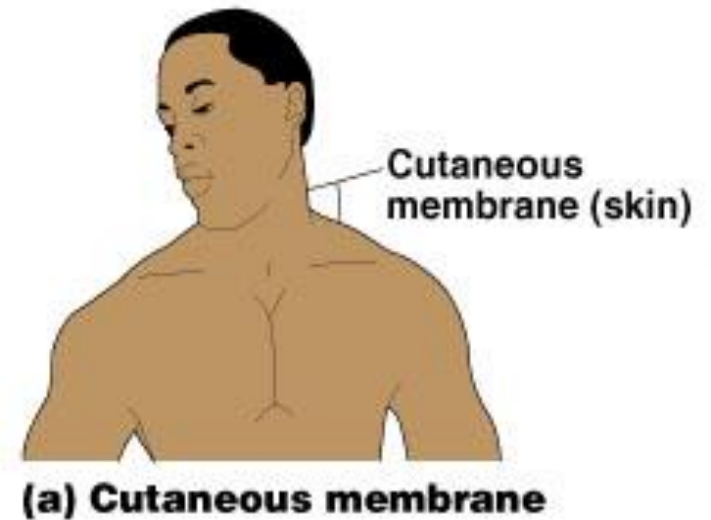
- List the general functions of each membrane type and give its location in the body.
- Compare the structure of major membrane types.

Classification of Body Membranes

- Epithelial membranes
 - Cutaneous membrane
 - Mucous membrane
 - Serous membrane
- Connective tissue membranes

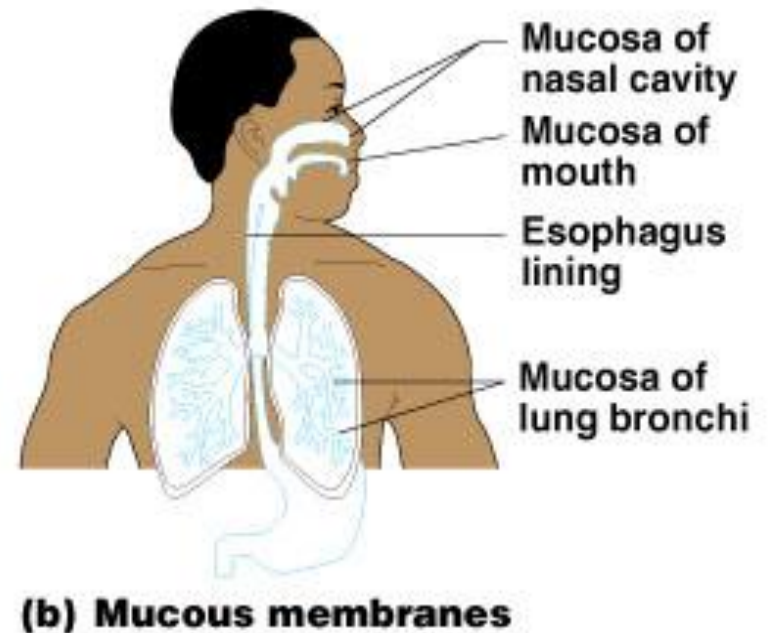
Cutaneous Membrane

- Cutaneous membrane = skin
 - A dry membrane
 - Outermost protective boundary
- Superficial epidermis
 - Keratinized stratified squamous epithelium
- Underlying dermis
 - Mostly dense connective tissue



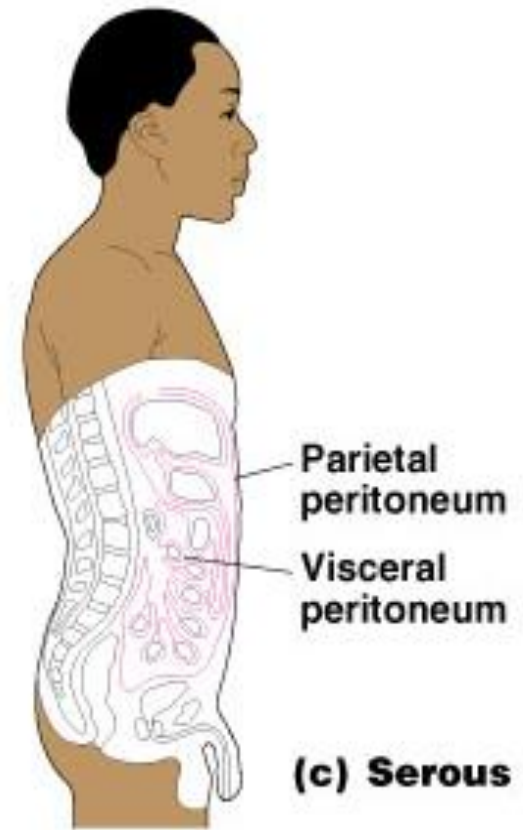
Mucous Membranes

- Surface epithelium
 - Type depends on site
- Underlying loose connective tissue (lamina propria)
- Lines all body cavities that open to the exterior body surface



Serous Membranes

- Surface simple squamous epithelium
- Underlying areolar connective tissue
- Lines body cavities that are closed to the exterior of the body
- Serous layers separated by serous fluid allows organs carry out their routine functions in frictionless manner.

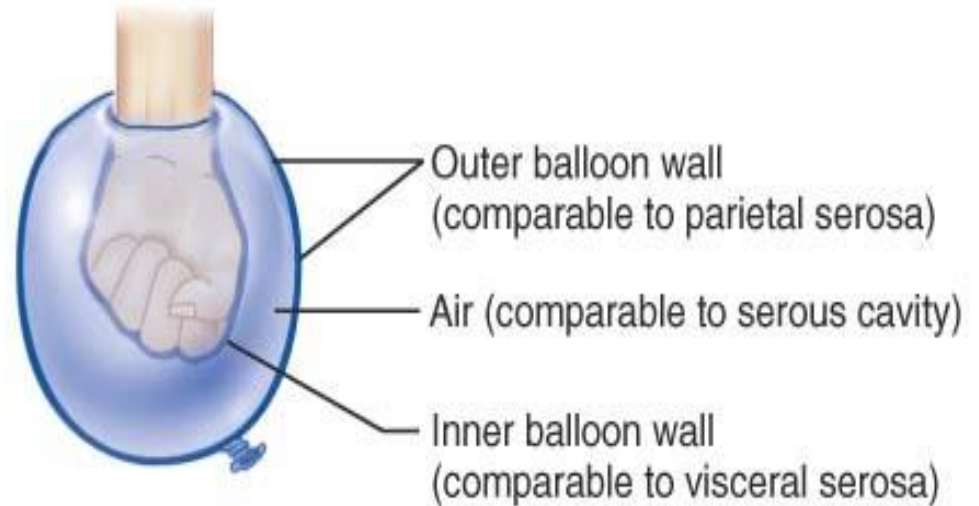


Serous Membranes

- Specific serous membrane names depending on their locations;
 - Peritoneum
 - Abdominal cavity
 - Pleura
 - Around the lungs
 - Pericardium
 - Around the heart

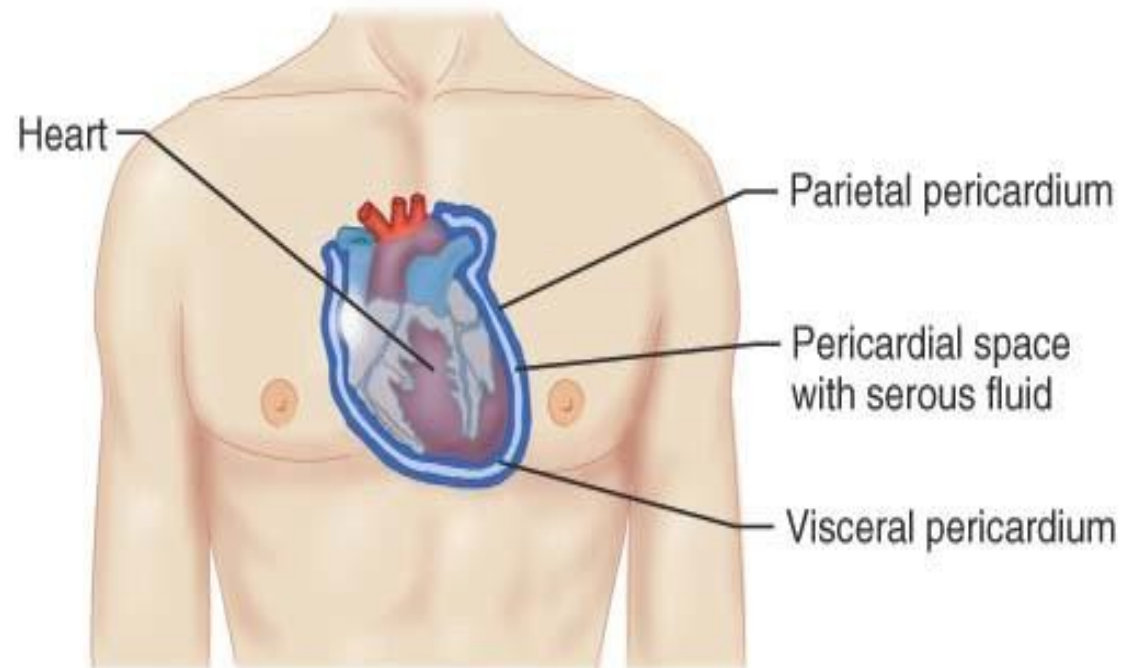
- They occur in pairs;

1) The *parietal layer* lines a specific portion of the wall of the ventral body cavity.



(a)

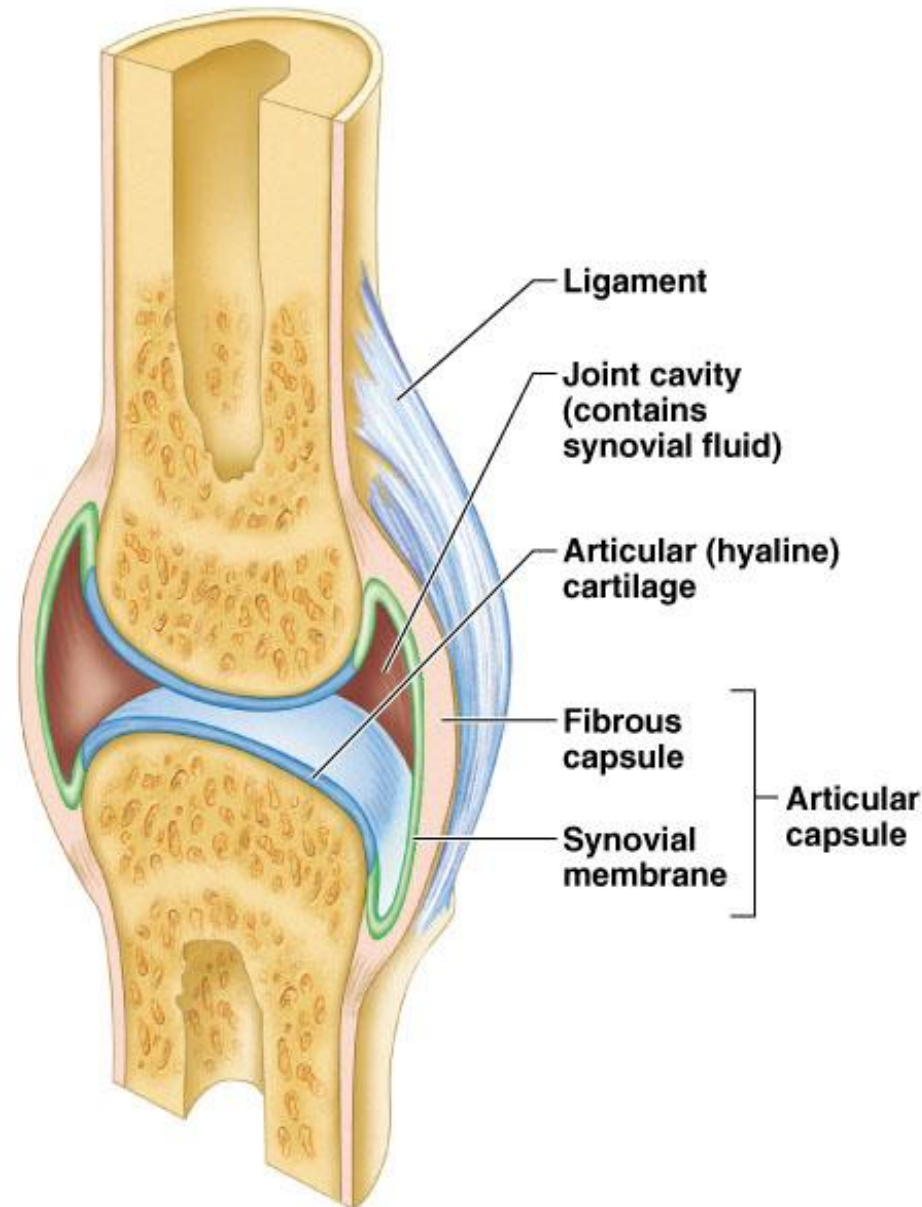
2) The parietal layer folds on its self to form the *visceral layer* which covers the outside of the organs in that cavity.



(b)

Connective Tissue Membrane

- Synovial membrane
 - Connective tissue only (no epithelial cells).
 - Lines fibrous capsules surrounding joints
 - Provide a smooth surface and secrete a lubricating fluid (synovial fluid).



Function of body membranes

- Line or cover body surfaces
- Protect body surfaces
- Lubricate body surfaces

2. Integumentary System

Objectives:

- List the important functions of the integumentary system, and explain how these functions are accomplished.
- List the parts that make up the system.

The integument is the largest system of the body.

The integument (Skin) is made up of 2 parts:

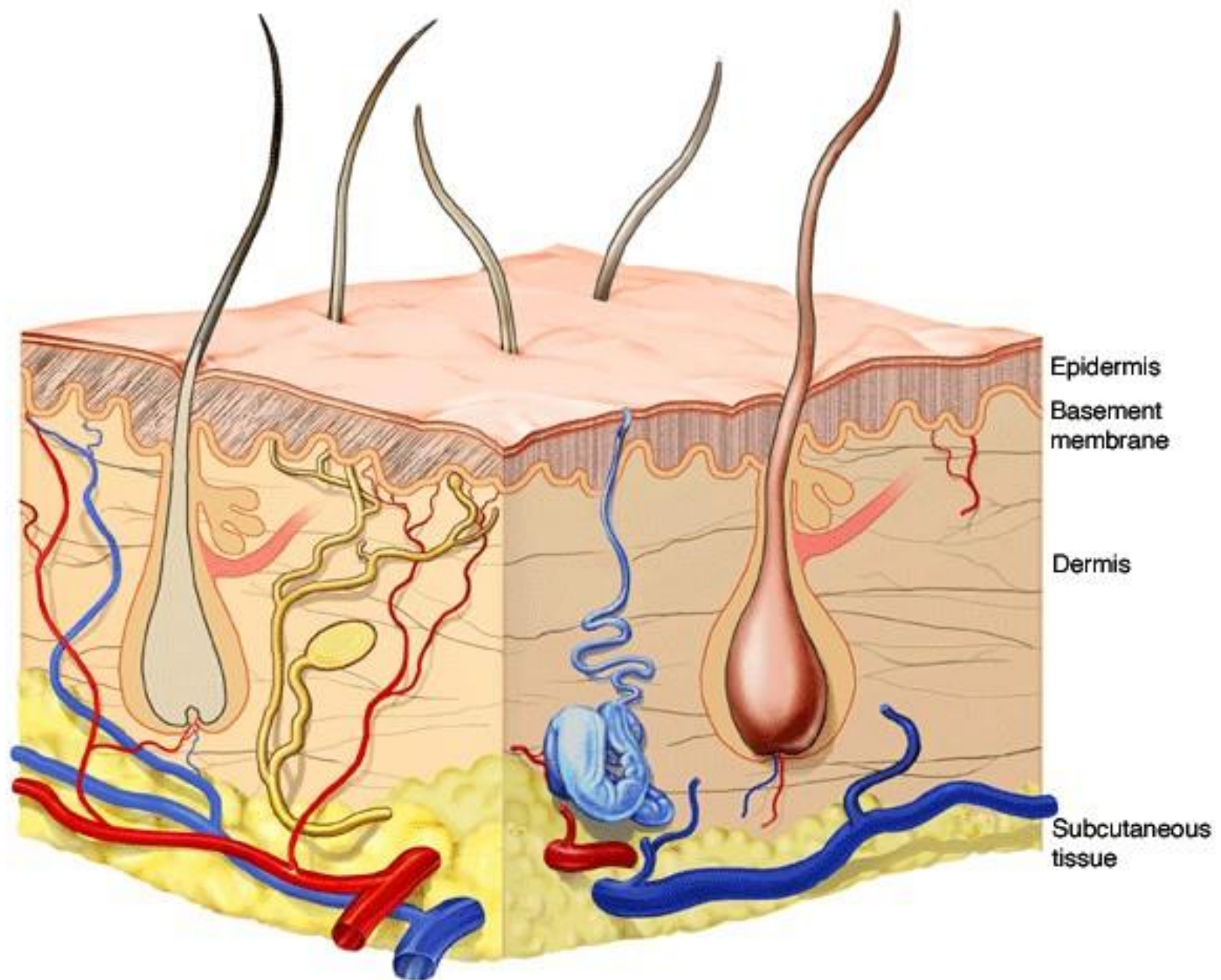
1. cutaneous membrane (skin)

- Outer epidermis:
 - superficial epithelium (epithelial tissues)
 - Made up of stratified squamous epithelium that is capable of keratinizing (hardening).
- Inner dermis:
 - Mostly dense connective tissues

2. accessory structures

- Originate in the dermis
- Extend through the epidermis to skin surface:
 - hair
 - nails
 - multicellular exocrine glands
- The epidermis and dermis are firmly connected but can get separated by friction.

Skin structure

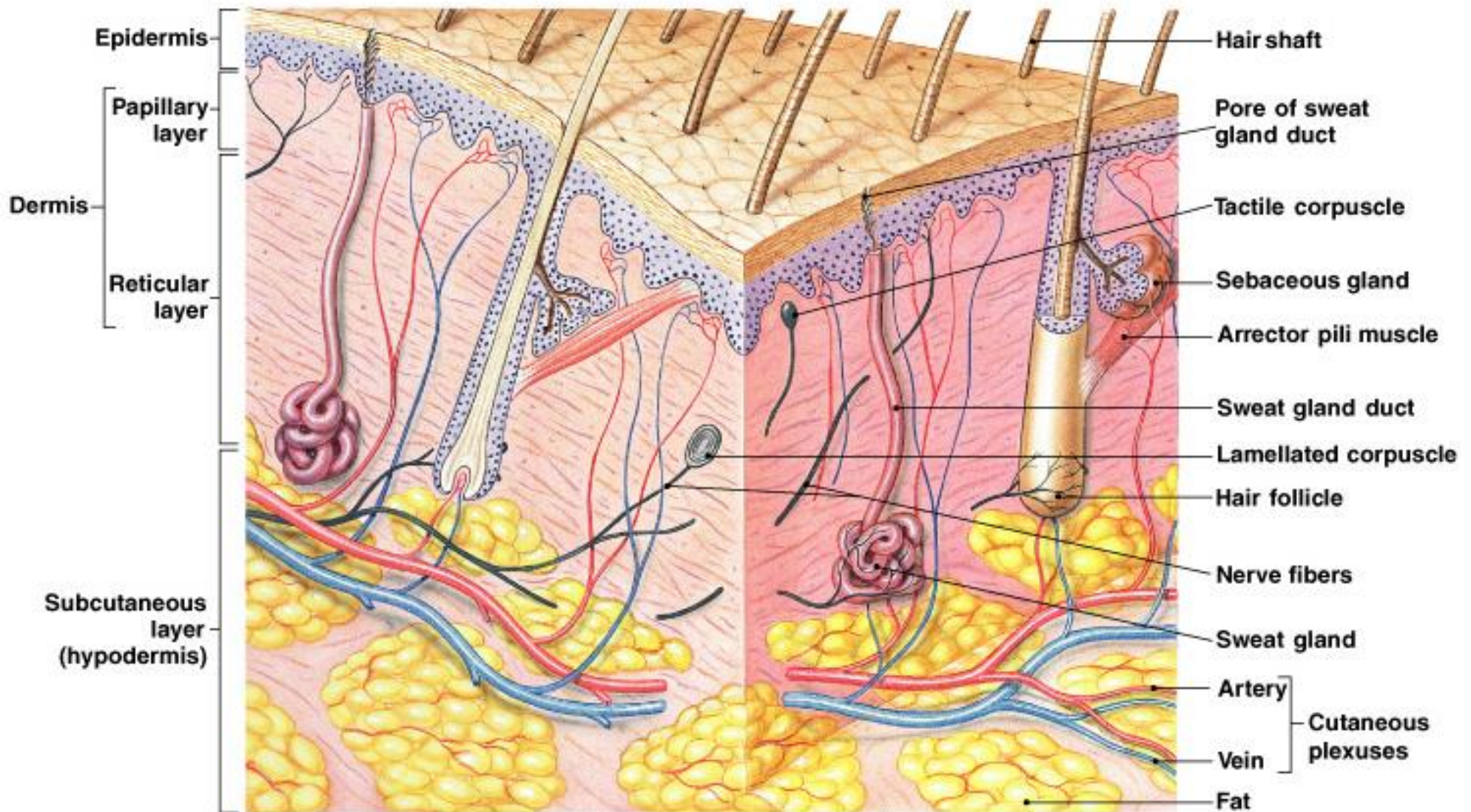


The Subcutaneous Layer

Subcutaneous layer (hypodermis):

- loose connective tissue (mostly adipose).
- below the dermis
- not considered part of the skin but it does anchor the skin to underlying organs and provides a site for fat storage.
- It serves as a shock absorber and insulates the deeper tissues from extreme temperature changes outside the body.

Parts of the Integumentary System



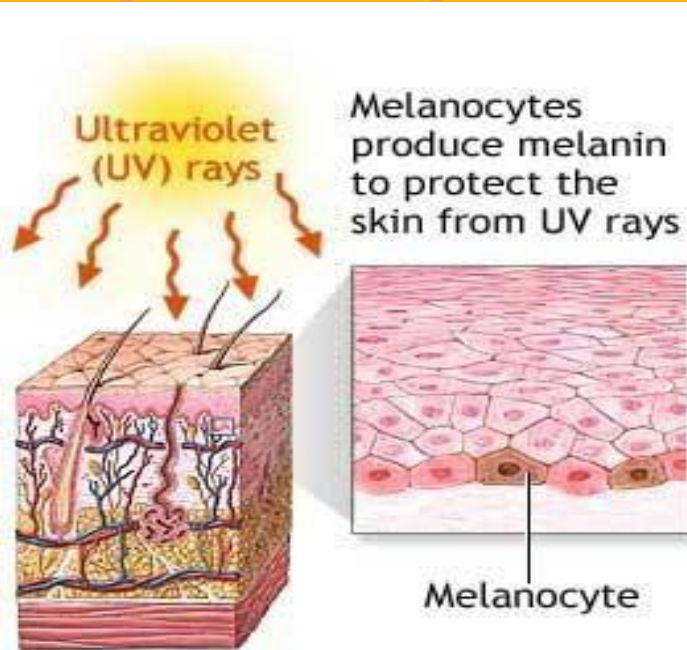
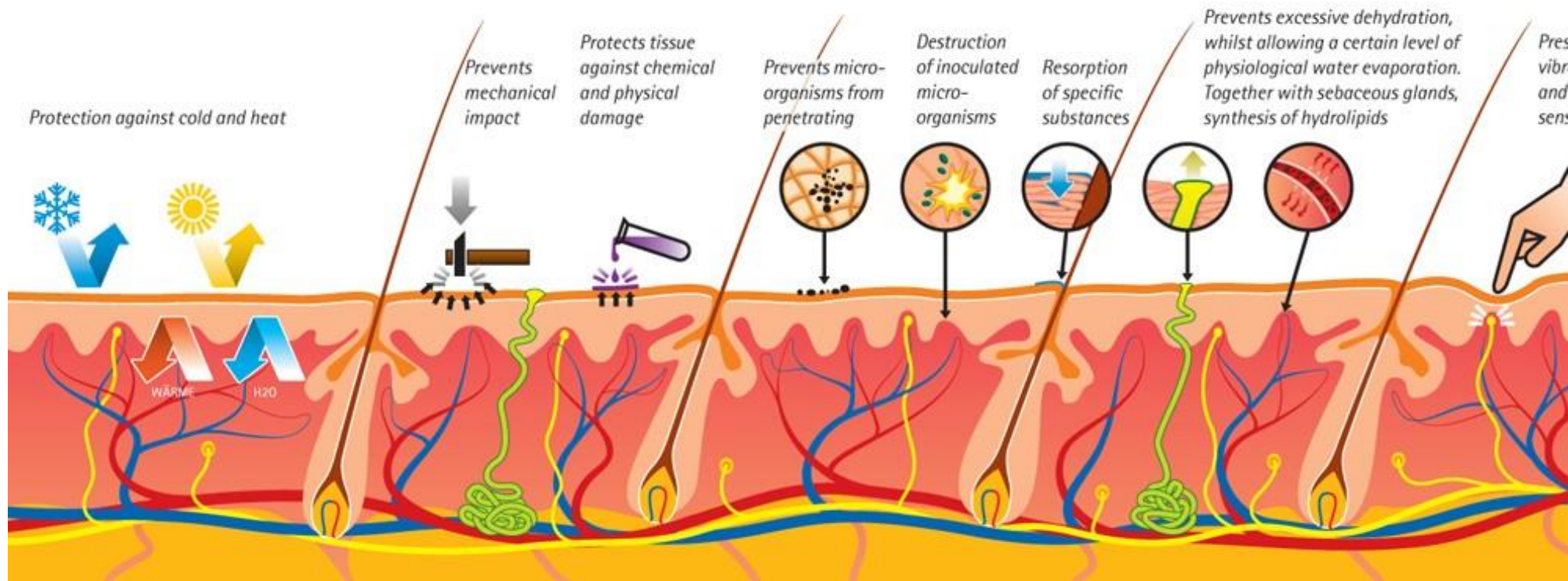
Connections

- Circulatory system:
blood vessels in the dermis.
- Nervous system:
sensory receptors in the dermis for pain,
touch, and temperature.

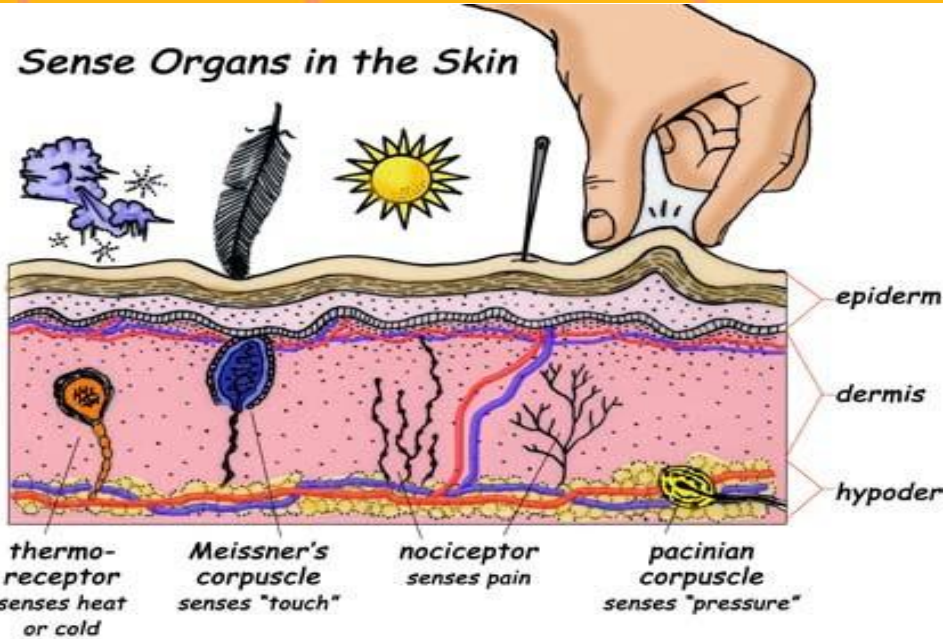
Functions of Skin

- *Protects* underlying tissues and organs.
- *Excretes* salts, water, and organic wastes (glands).
- *Maintains* body temperature (insulation and evaporation).
- *Synthesizes* vitamin D₃.
- *Stores* lipids.
- *Detects* touch, pressure, pain, and temperature.
- Changes in skin appearance are used to diagnose disorders in other systems.

Function	How accomplished
Protection: 1)UV radiation 2)Thermal damage 3)Chemical damage 4)Mechanical damage 5)Bacterial damage 6)Dehydraion	1)Melanocytes produce melanin protect from UV damage. 2)Contain heat/cold/pain receptors. 3)Pain receptors/ relatively impermeable keratinized cells. 4)Pressure receptors/ keratinized cells/ desmosomes. 5)keratin/Intact surface/ acidic dry surface/ phagocytes. 6)Contains lipids that prevent drying out.
Sensation	Sensory receptors provide us with info on external env.
Heat regulation (controlled by the nervous system that Change BV diameter according to temperature).	Heat loss: by activating sweat glands + vasodilation. Heat retention: Vasoconstriction.
Absorption	Moist, Creams, oils and medicines.
Excretion of waste	Urea and uric acid contained in perspiration produced by sweat glands.
Secretion	Sweat.
Vitamin D production	Cholesterol in skin converts to Vitamin D by sunlight.



If UV rays exceed what can be blocked by your level of melanin, sunburn results



***What are the main
structures and functions
of the epidermis?***

structures and functions of the epidermis

- Avascular (no blood supply of its own) stratified squamous epithelium.
- Nutrients and oxygen diffuse from capillaries in the dermis
- Cells of the epidermis:

Keratinocytes:

contain large amounts of keratin (fibrous protein) the most abundant cells in the epidermis.

THIN SKIN:

- Covers most of the body
- Has 4 layers of keratinocytes

THICK SKIN:

- Covers the palms of the hands and soles of the feet
- Has 5 layers of keratinocytes

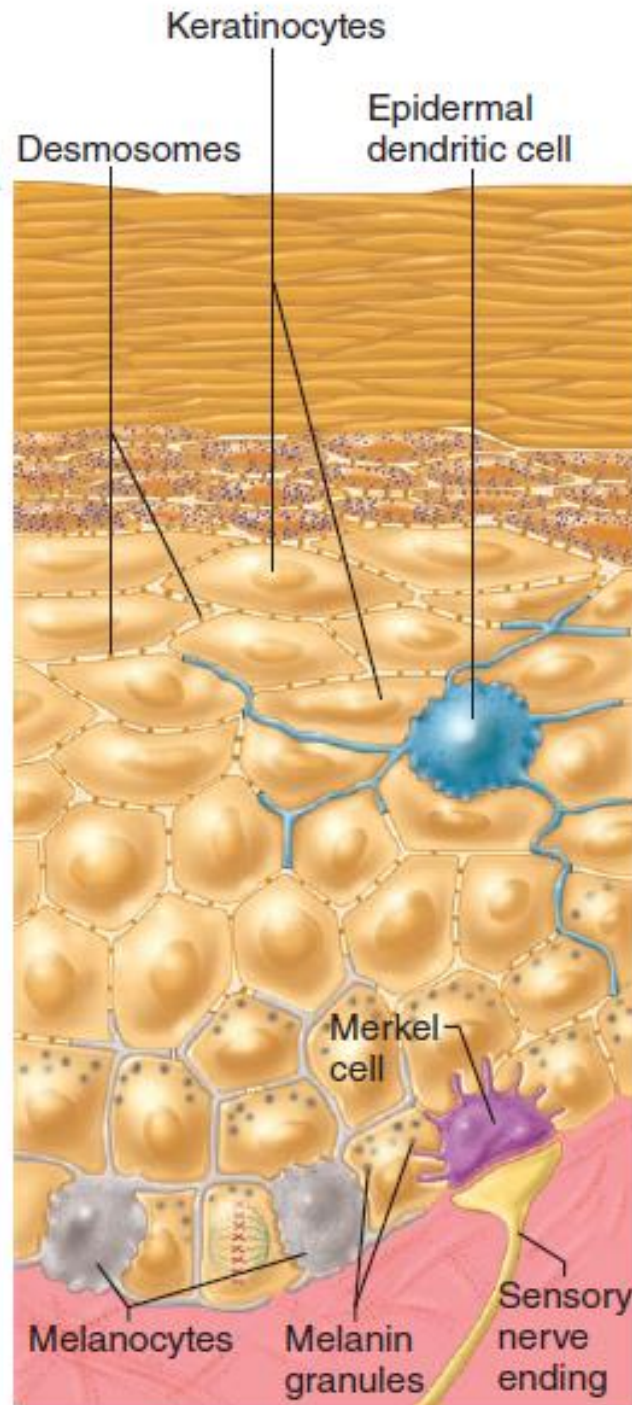
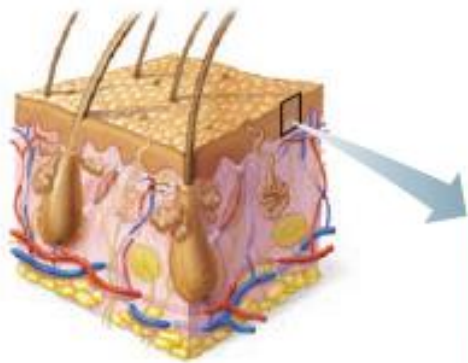
Epidermis

The epidermis is mainly composed of five layers (*strata*) :

- *the stratum basale (germinativum)*
- *the stratum spinosum*
- *the stratum granulosum*
- *the stratum lucidum*
- *the stratum corneum*

*(*stratum lucidum* is found only in thick skin).

Layer	Cells
stratum basale (germinativum) *(inner most, other layers generated from it) Cont. dividing	<ul style="list-style-type: none"> • Merkel cells: found in hairless skin ,respond to touch (trigger nervous system) • Melanocytes: contain the pigment melanin scattered throughout stratum germinativum
stratum spinosum	Contain Langerhans cells, active in immune response
stratum granulosum	<ul style="list-style-type: none"> • <u>Stops dividing</u>, starts producing: <ul style="list-style-type: none"> • keratin. • keratohyalin (dense granules cross-link keratin fibers)
stratum lucidum	<ul style="list-style-type: none"> • found only in thick skin covers stratum granulosum • Cells are Flat, Dense, Filled with keratin.
stratum corneum	The outermost layer, 20 to 30 cell layers thick of dead cells filled with keratin. <ul style="list-style-type: none"> • This layer is the most abundant in keratin. • rubs and flakes off (dandruff) • This layer is replaced by cells produced by the division stratum basale cells. • we have a totally “new” epidermis every 25 to 45 days.



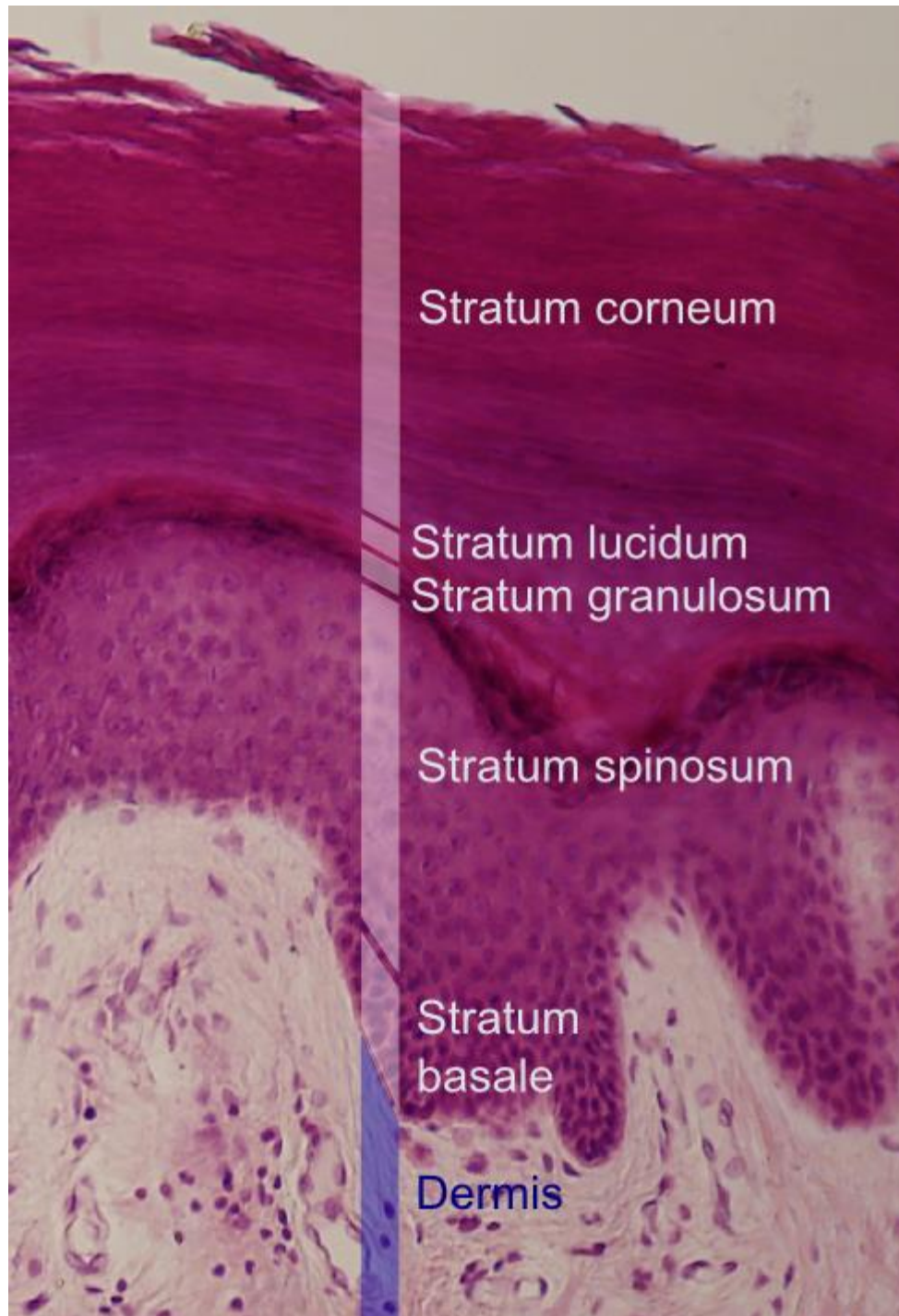
Stratum corneum. Cells are dead; represented only by flat membranous sacs filled with keratin. Glycolipids in extracellular space.

Stratum granulosum. Cells are flattened, organelles are deteriorating; cytoplasm full of granules.

Stratum spinosum. Cells contain thick bundles of intermediate filaments made of pre-keratin.

Stratum basale. Cells are actively dividing stem cells; some newly formed cells become part of the more superficial layers.

Dermis



Skin color

Skin color depends on:

- the pigments **carotene** and **melanin**
- blood circulation (red cells)

Carotene

- Orange-yellow pigment
- Found in orange vegetables
- Accumulates in epidermal cells and fatty tissues of the dermis
- Can be converted to vitamin A



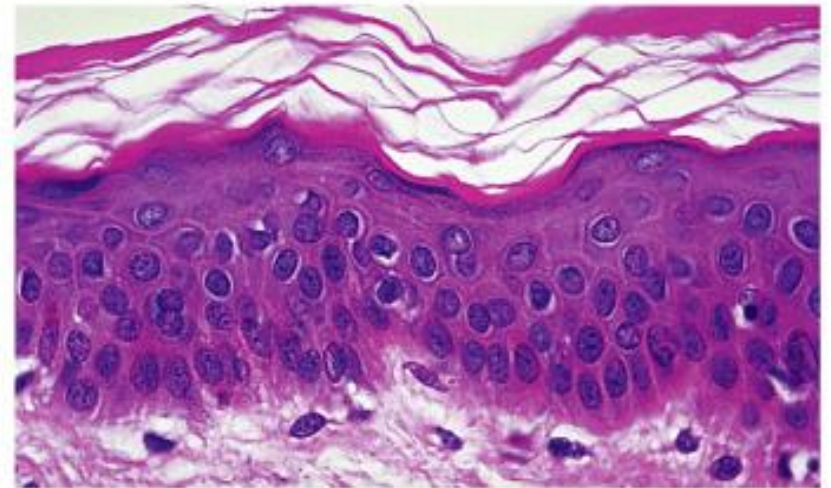
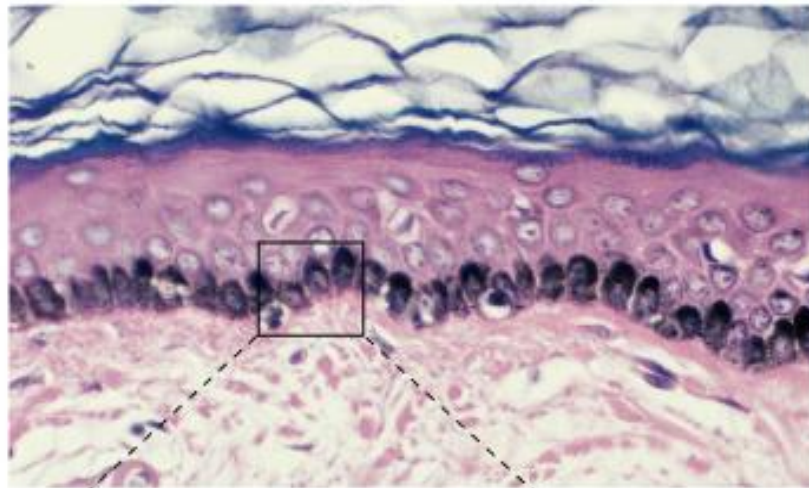
Melanin

- Yellow-brown or black pigment
- Produced by **melanocytes** in stratum germinativum
- Stored in transport vesicles (**melanosomes**)
- Transferred to keratinocytes

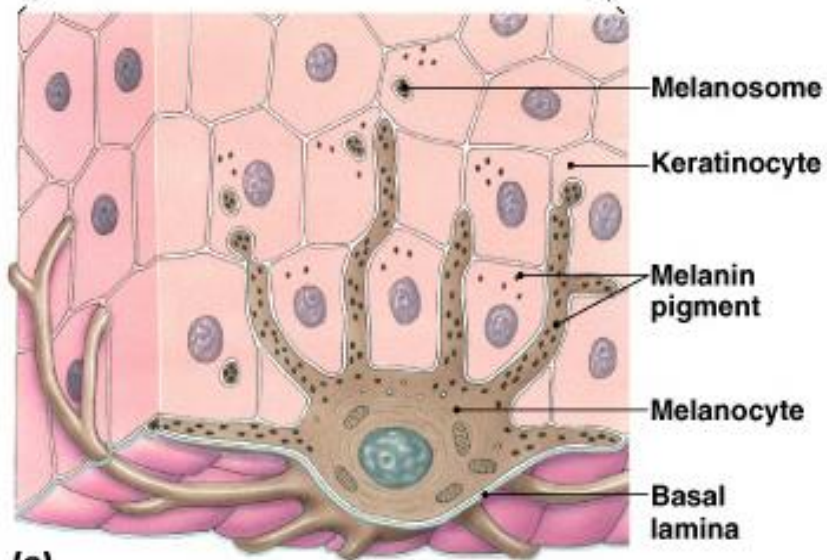
Function of Melanocytes

- Melanin protects skin from sun damage
- Ultraviolet (UV) radiation:
 - causes DNA mutations and burns which lead to cancer and wrinkles
- Give the skin color
 - Skin color depends on melanin production, not number of melanocytes

Melanocytes



(b)



(a)

Figure 5-5

Capillaries and Skin Color

- Oxygenated red blood contributes to skin color:
 - blood vessels dilate from heat, skin reddens
 - blood flow decreases, skin pales

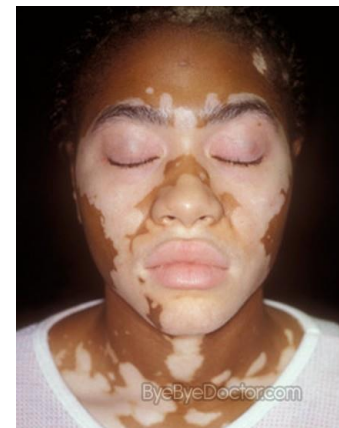
Cyanosis

- Bluish skin tint
- Caused by severe reduction in blood flow or oxygenation.
- Argyria (Silver intake).



Illness and Skin Color

- **Jaundice:**
 - buildup of bile produced by liver
 - yellow color
- **Addison's disease:**
 - and other diseases of **pituitary gland**
 - skin darkening
- **Vitiglio:**
 - loss of melanocytes
 - loss of color



Albinism

- is a congenital disorder characterized by the complete or partial absence of pigment in the skin, hair and eyes.
- caused by absence or defect in the enzyme involved in the production of melanin.
- inheritance of recessive gene alleles.



Vitamin D

- Epidermal cells produce **cholecalciferol** (vitamin D₃):
 - in the presence of UV radiation
- Liver and kidneys convert vitamin D into **calcitriol**:
 - to aid absorption of calcium and phosphorus
- Insufficient vitamin D:
 - can cause *rickets*

KEY CONCEPT

- The epidermis:
 - is a multilayered, flexible, self-repairing barrier
 - prevents fluid loss
 - protects from UV radiation
 - produces vitamin D₃
 - resists abrasion, chemicals, and pathogens

What are the structures and functions of the dermis?

The Dermis

- Is located between epidermis and subcutaneous layer
- Anchors epidermal accessory structures (hair follicles, sweat glands)
- Has 2 components:
 - outer papillary layer
 - deep reticular layer

The Papillary Layer

- Consists of areolar tissue
- Contains smaller capillaries, lymphatics, and sensory neurons

The Reticular Layer

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

- Arteries
 - a network of arteries along the reticular layer
 - capillary network from small arteries in papillary layer
- Nerves
 - Nerve fibers in skin control:
 - blood flow
 - gland secretions
 - sensory receptors

Characteristics of Dermis

- Strong, due to collagen fibers
- Elastic, due to elastic fibers
- Flexible

Dermatitis

- An inflammation of the papillary layer
- Caused by infection, radiation, mechanical irritation, or chemicals (*e.g.*, poison ivy)
- Characterized by itch or pain.
 - E.g.:
 - Athletes foot
 - Caused by fungal infection
 - Boils and carbuncles
 - Caused by bacterial infection
 - Cold sores
 - Caused by virus

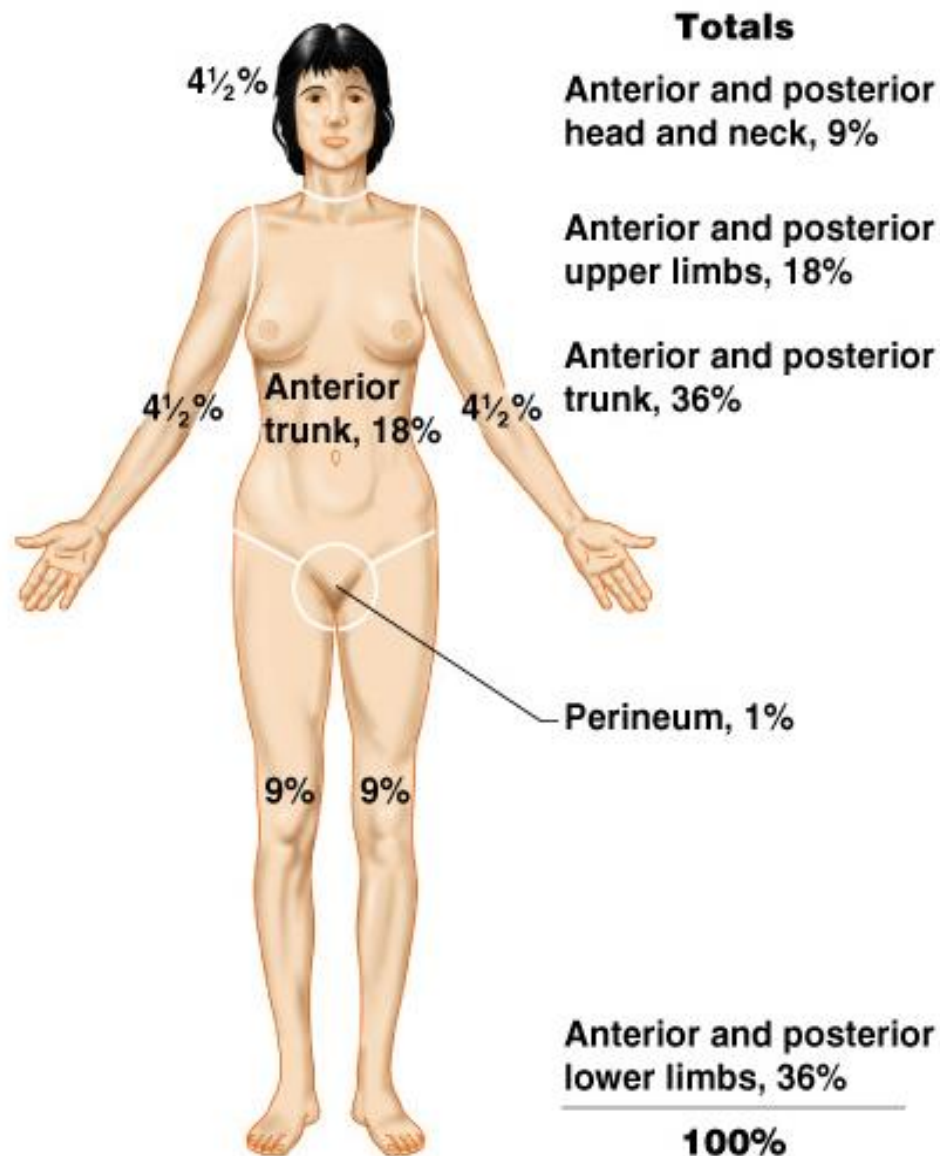


Burns

- Tissue damage and cell death caused by heat, electricity, UV radiation, or chemicals
- Associated dangers
 - Dehydration
 - Electrolyte imbalance
 - Circulatory shock

Rule of Nines

- Way to determine the extent of burns
- Body is divided into 11 areas for quick estimation
 - Each area represents about 9%



(a)

Severity of Burns

- First-degree burns
 - Only epidermis is damaged
 - Skin is red and swollen
- Second degree burns
 - Epidermis and upper dermis are damaged
 - Skin is red with blisters
- Third-degree burns
 - Destroys entire skin layer
 - Burn is gray-white or black

Skin Cancer Types

- Basal cell carcinoma
 - Least malignant and most common
 - Arises from stratum basale
- Squamous cell carcinoma
 - Arises from stratum spinosum
 - Grows rapidly and metastasizes
- Malignant melanoma
 - Most deadly of skin cancers
 - Cancer of melanocytes

Skin Cancer



(a) Basal cell carcinoma



(b) Melanoma

Lines of Cleavage

- Collagen and elastic fibers in the dermis:
 - are arranged in parallel bundles
 - resist force in a specific direction
- Lines of cleavage establish important patterns:
 - a parallel cut remains shut, heals well
 - a cut across (right angle) pulls open and scars



KEY CONCEPT

- The dermis:
 - provides mechanical strength, flexibility and protection
 - is highly vascularized
 - contains many types of sensory receptors

***What are the structures
and functions of the subcutaneous
layer?***

The Hypodermis

- The **subcutaneous layer** or **hypodermis**:
 - lies below the integument
 - stabilizes the skin
- The subcutaneous layer is:
 - made of elastic areolar and adipose tissues
 - connected to the reticular layer of integument by connective tissue fibers
- Clinical Importance:
 - is the site of **subcutaneous injections** using **hypodermic needles**

Adipose Tissue

- Deposits of subcutaneous fat:
 - have distribution pattern determined by hormones
 - are reduced by cosmetic liposuction

Cutaneous glands

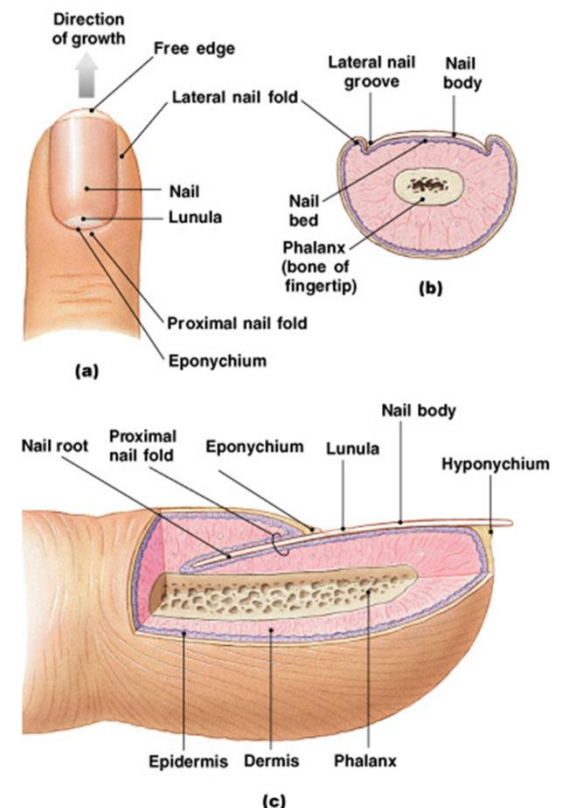
- exocrine glands that release their secretions to the skin surface via ducts.
- They fall into two groups: sebaceous glands and sweat glands.
- As these glands are formed by the cells of the stratum basale, they push into the deeper skin regions and ultimately reside almost entirely in the dermis.

Sebaceous Glands

- Sebaceous (Oil) Glands, are found all over the skin, except on the palms of the hands and the soles of the feet.
- Their ducts usually empty into a hair follicle but some open directly onto the skin surface.
- The product of the sebaceous glands is sebum is a mixture of oily substances
- and fragmented cells.
- Sebum is a lubricant that keeps the skin soft and moist and prevents the hair from becoming brittle.
- Sebum also contains chemicals that kill bacteria, so it is important in preventing the bacteria present on the skin surface from invading the deeper skin regions.
- The sebaceous glands become very active when male sex hormones are produced in increased amounts during adolescence.

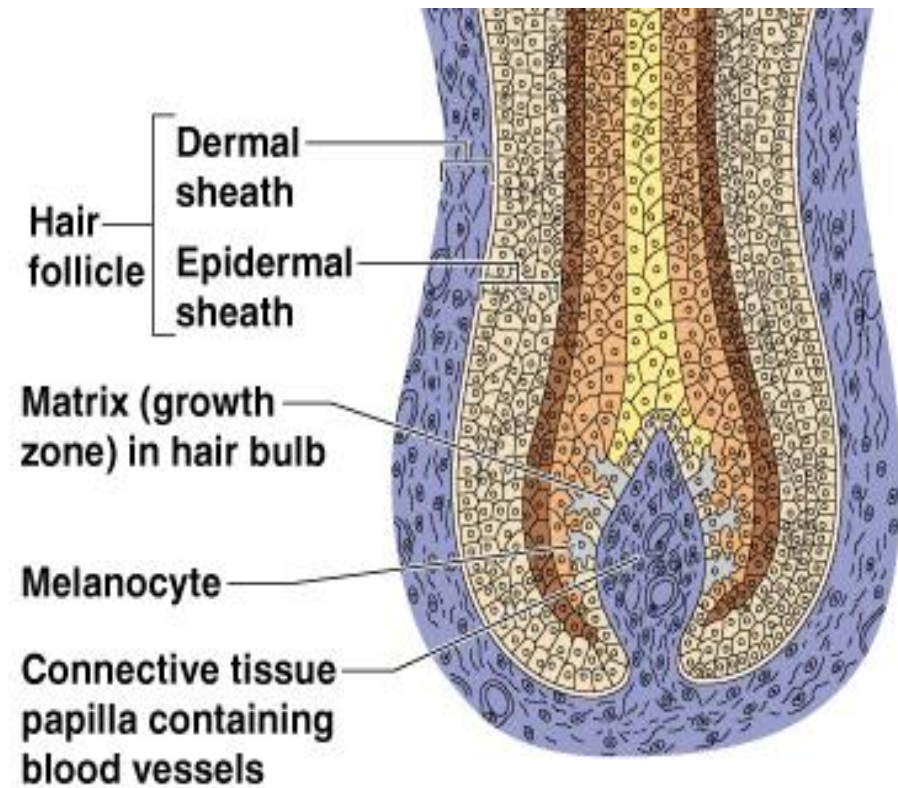
Nail Functions

- Nails protect fingers and toes:
 - made of dead cells packed with keratin
 - metabolic disorders can change nail structure
 - Lack of pigment makes them colorless.



Hair

- Produced by hair bulb
 - Consists of hard keratinized epithelial cells.
 - Melanocytes provide pigment for hair color.



***How does injured skin
respond and repair itself?***

Repair of Localized Injuries to the Skin: Step 1

- Bleeding occurs
- Mast cells trigger inflammatory response

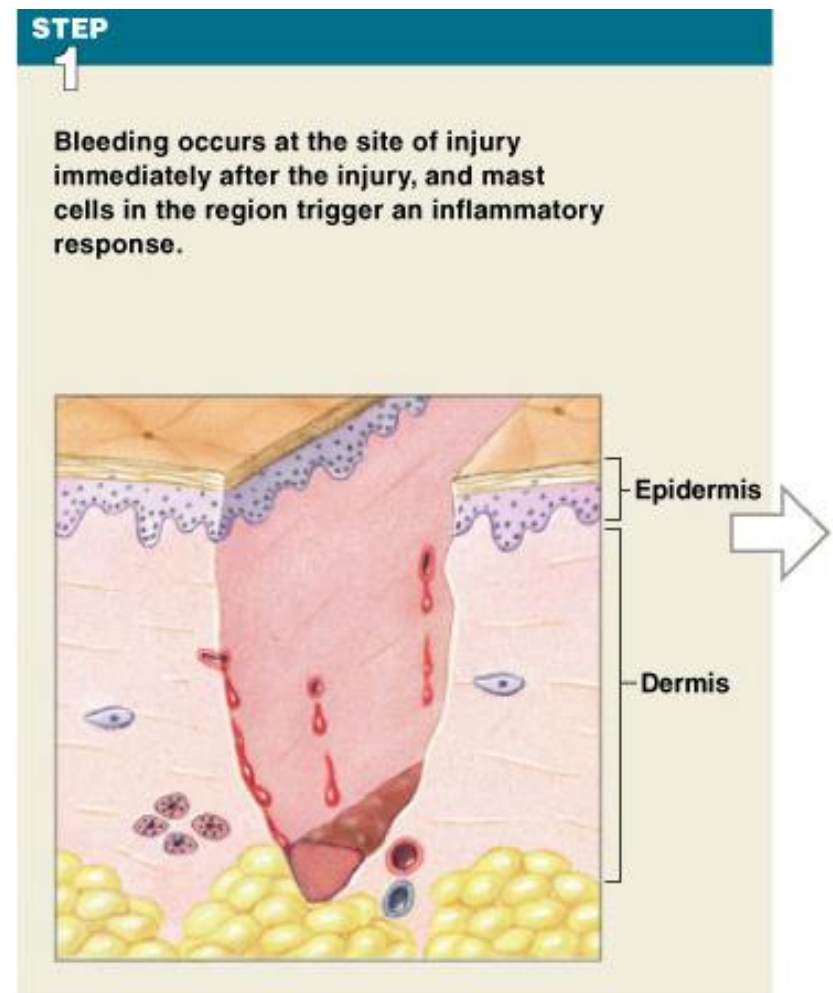


Figure 5-13 (Step 1)

The Inflammatory Response

- Germinative cells migrate around the wound
- Macrophages clean the area
- Fibroblasts and endothelial cells move in, producing granulation tissue

Repair of Localized Injuries to the Skin: Step 2

- A **scab** stabilizes and protects the area

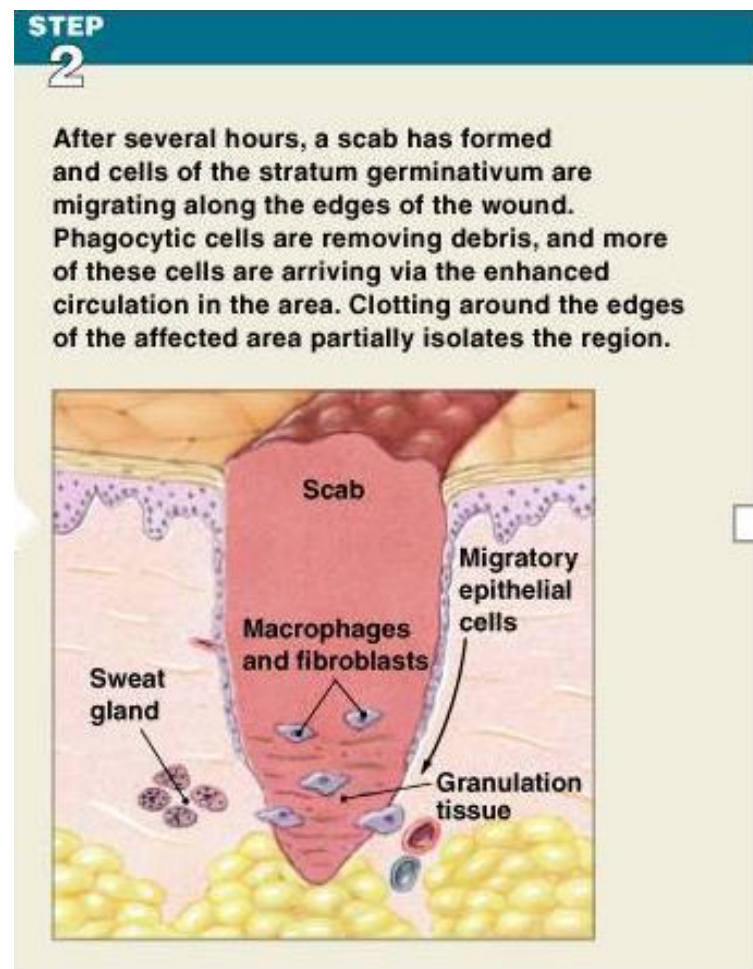


Figure 5-13 (Step 2)

Repair of Localized Injuries to the Skin: Step 3

- Fibroblasts produce **scar tissue**
- Inflammation decreases, clot disintegrates

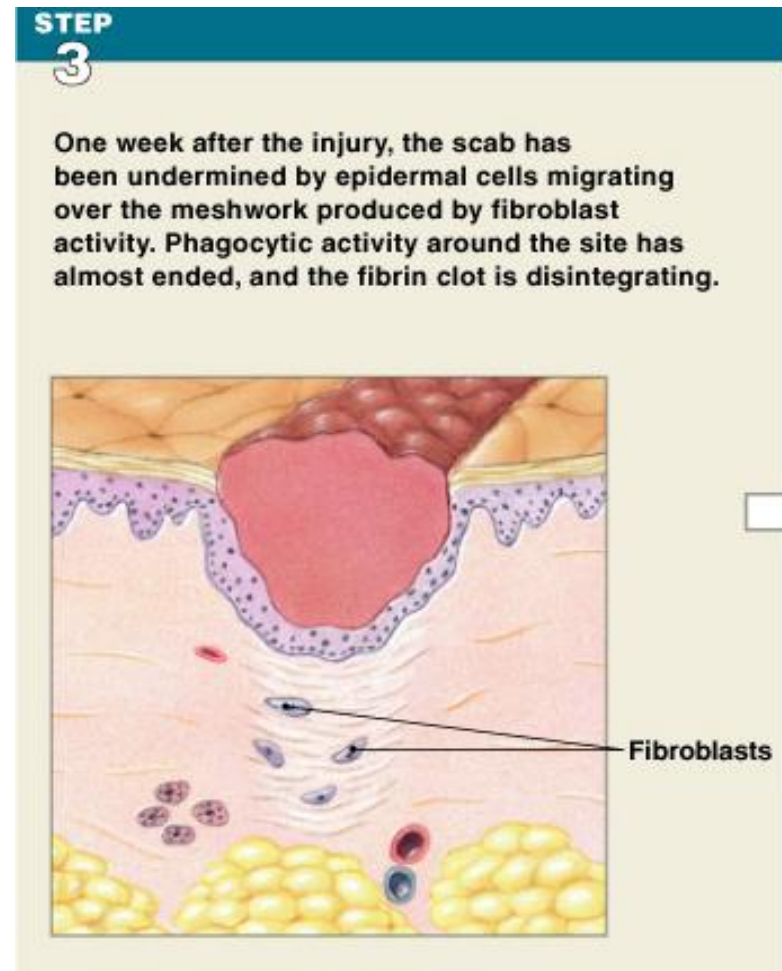


Figure 5-13 (Step 3)

Repair of Localized Injuries to the Skin: Step 4

- Fibroblasts strengthen scar tissue
- A raised **keloid** forms

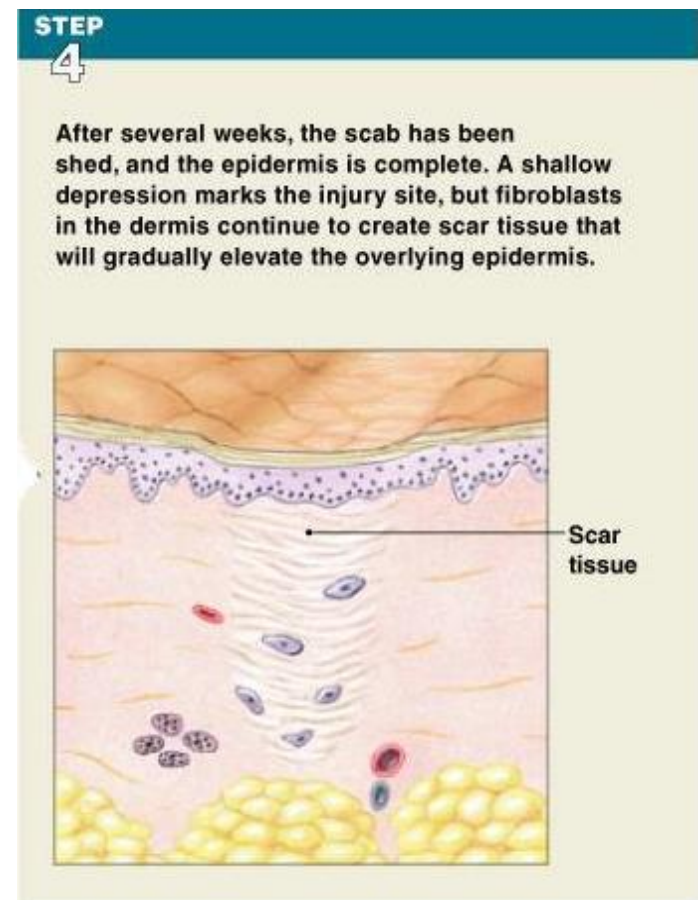


Figure 5-13 (Step 4)

***What are the effects
of aging on the skin?***

Effects of Aging

- Epidermal thinning
- Decreased numbers of Langerhans cells
- Decreased vitamin D₃ production
- Decreased melanocyte activity
- Decreased glandular activity (sweat and oil glands)

Effects of Aging

- Reduced blood supply
- Decreased function of hair follicles
- Reduction of elastic fibers
- Decreased hormone levels
- Slower repair rate