



# General Education Program

# Physiology 1



## I-Integumentary System

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**Presented by:**

***Dr. Shaimaa Nasr Amin***

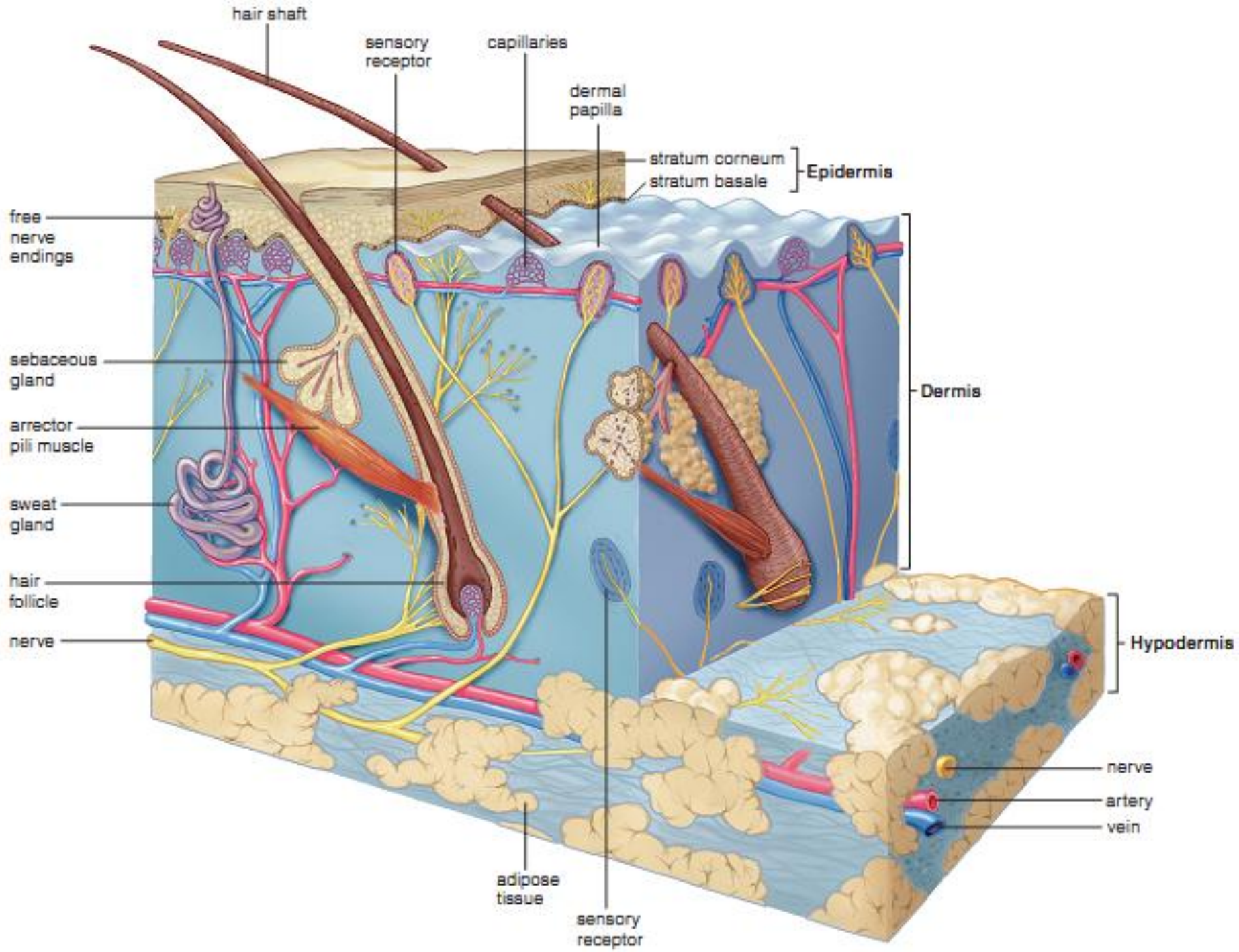
**Lecturer of Medical Physiology**

# Objectives:

- Understand the structure of the skin.
- Understand the functions of the skin
- Understand the disorders of the skin
- Understand how aging affects the skin
- Understand How the Integumentary System works with other body systems

# Structure Of The Skin

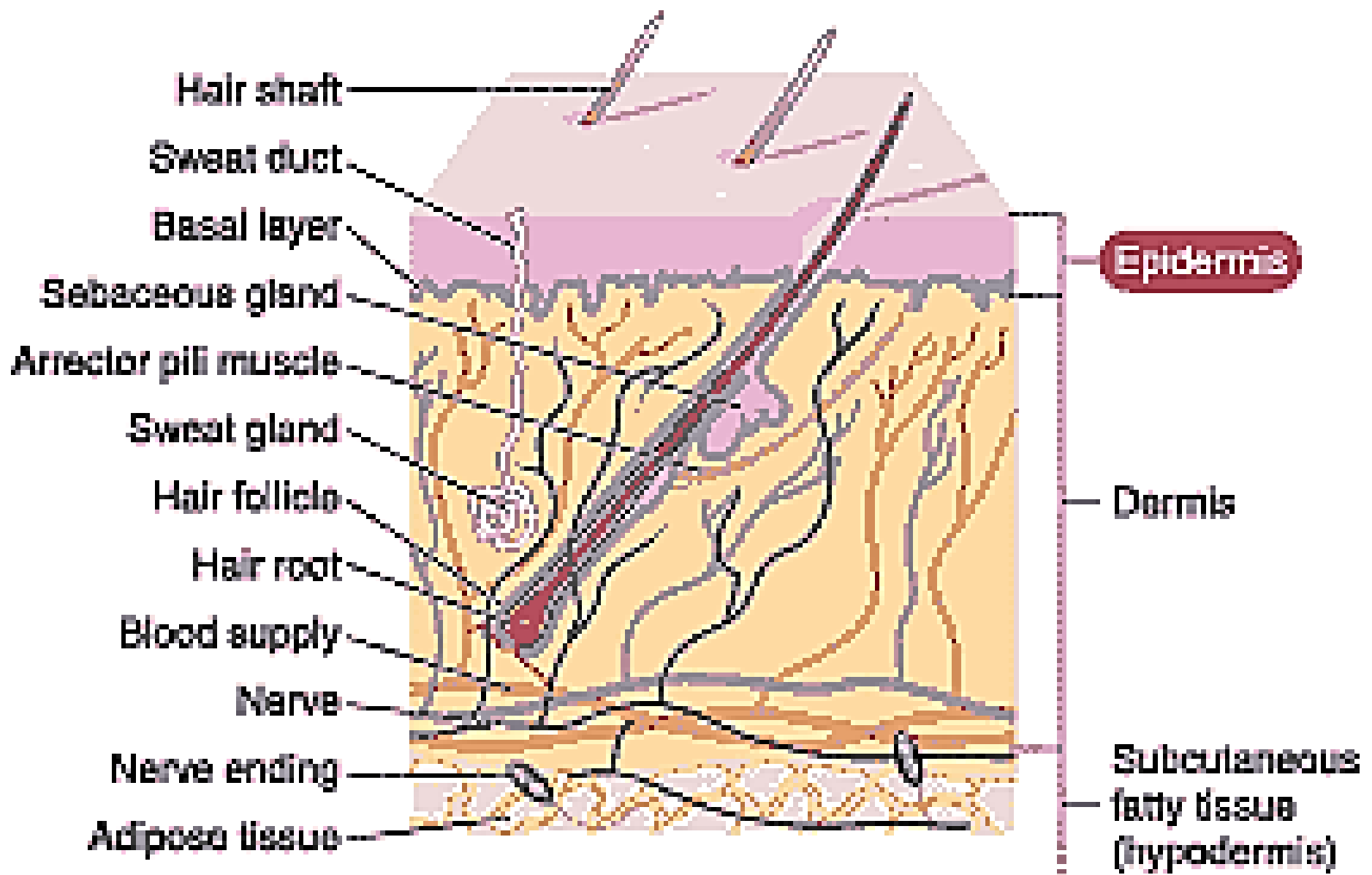
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# Structure of the Skin

- The skin covers the entire surface of the human body. In an adult, the skin has a surface area of about 1.8 square meters
- The skin is sometimes called the cutaneous membrane or the integument. Because the skin has several accessory organs, it is also called the integumentary system.

- The skin has two regions: the epidermis and the dermis. The hypodermis, a subcutaneous tissue, is found between the skin and any underlying structures, such as muscle.



- Usually, the hypodermis is only loosely attached to underlying muscle tissue, but where no muscles are present, the hypodermis attaches directly to bone. For example, there are flexion creases where the skin attaches directly to the joints of the fingers



# Epidermis

- The epidermis is the outer and thinner region of the skin.
- It is made up of stratified squamous epithelium divided into several layers; the deepest layer is the stratum basale, and the most superficial layer is the stratum corneum.

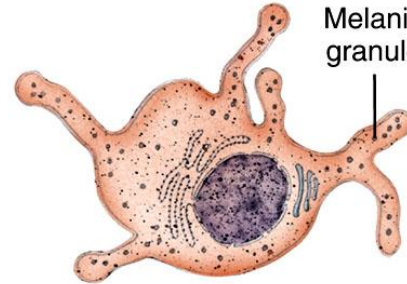
# Types of Cells in the Epidermis

Intermediate filament (keratin)

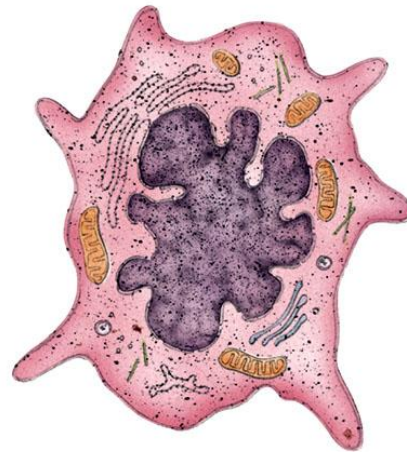


(a) Keratinocyte

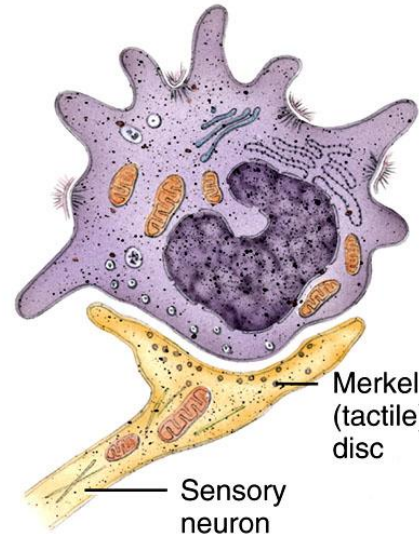
Melanin granule



(b) Melanocyte



(c) Langerhans cell



(d) Merkel cell

# Keratinocytes

- 95% of the cells in the epidermis are keratinocytes.
- These cells are found in the basal layer of the stratified epithelium that comprises the epidermis, and are sometimes referred to as basal cells, or basal keratinocytes.

# Keratinocytes

- These cells are responsible for forming tight junctions with the nerves of the skin. They also keep Langerhans cells of the epidermis, and lymphocytes of the dermis, in place.

# Keratinocytes

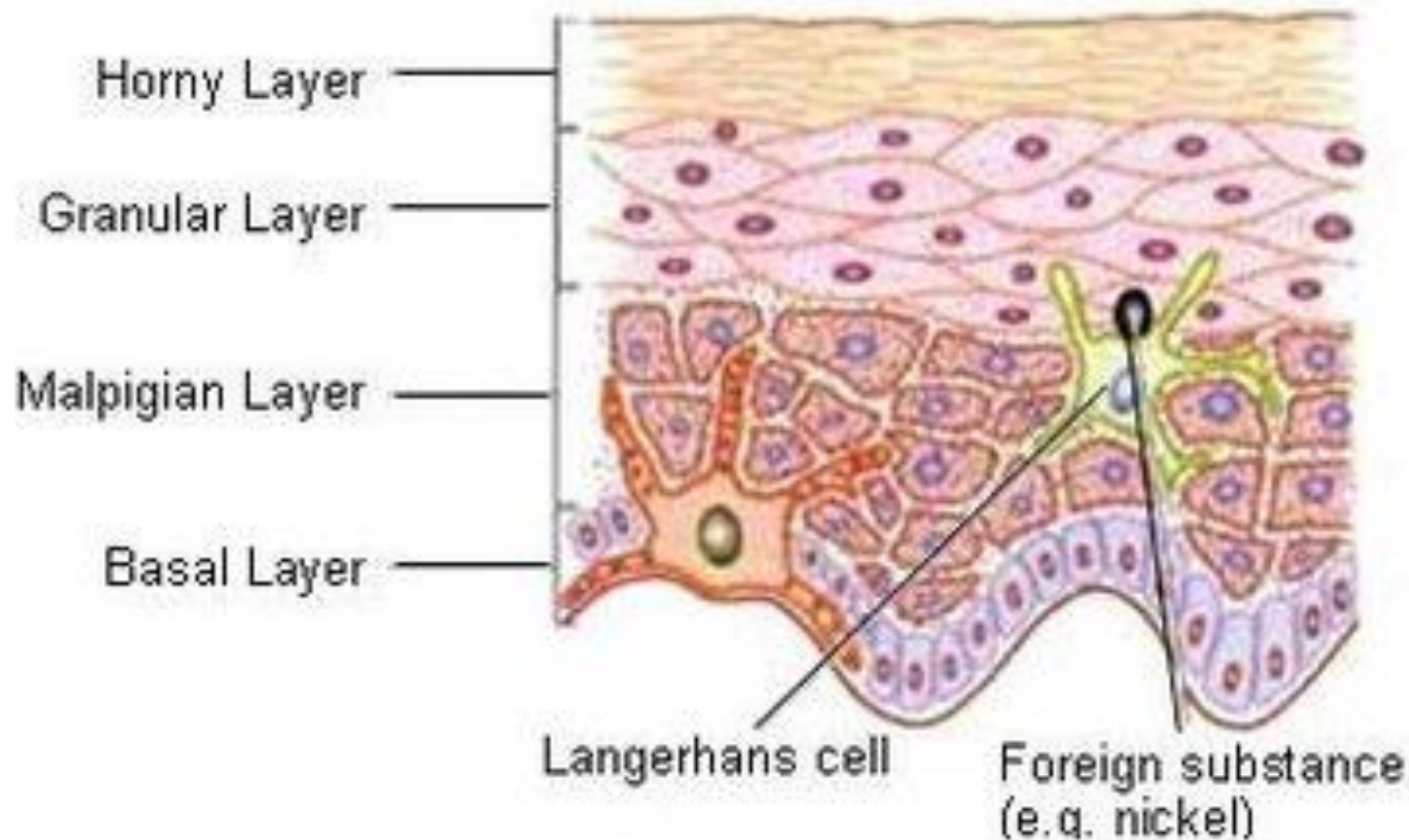
- **Immune role of keratinocytes:**
- In addition to their structural role, keratinocytes play a role in immune system function. The skin is the first line of defense, and keratinocytes serve as a barrier between an organism and its environment.

# Keratinocytes

- **Immune role of keratinocytes:**
- keratinocytes serve a chemical immune role as immunomodulators, responsible for secreting inhibitory cytokines in the absence of injury, and stimulating inflammation and activating Langerhans cells, in response to injury.

# Langerhans cells

Are macrophages found deep in the epidermis. Macrophages are related to monocytes, white blood cells produced in red bone marrow. These cells phagocytize microbes and then travel to lymphatic organs, where they stimulate the immune system to react.





# Melanocytes

- are another type of specialized cell located in the deeper epidermis.
- Melanocytes produce melanin, the pigment primarily responsible for skin color. Since the number of melanocytes is about the same in all individuals, variation in skin color is due to the amount of melanin produced and its distribution.

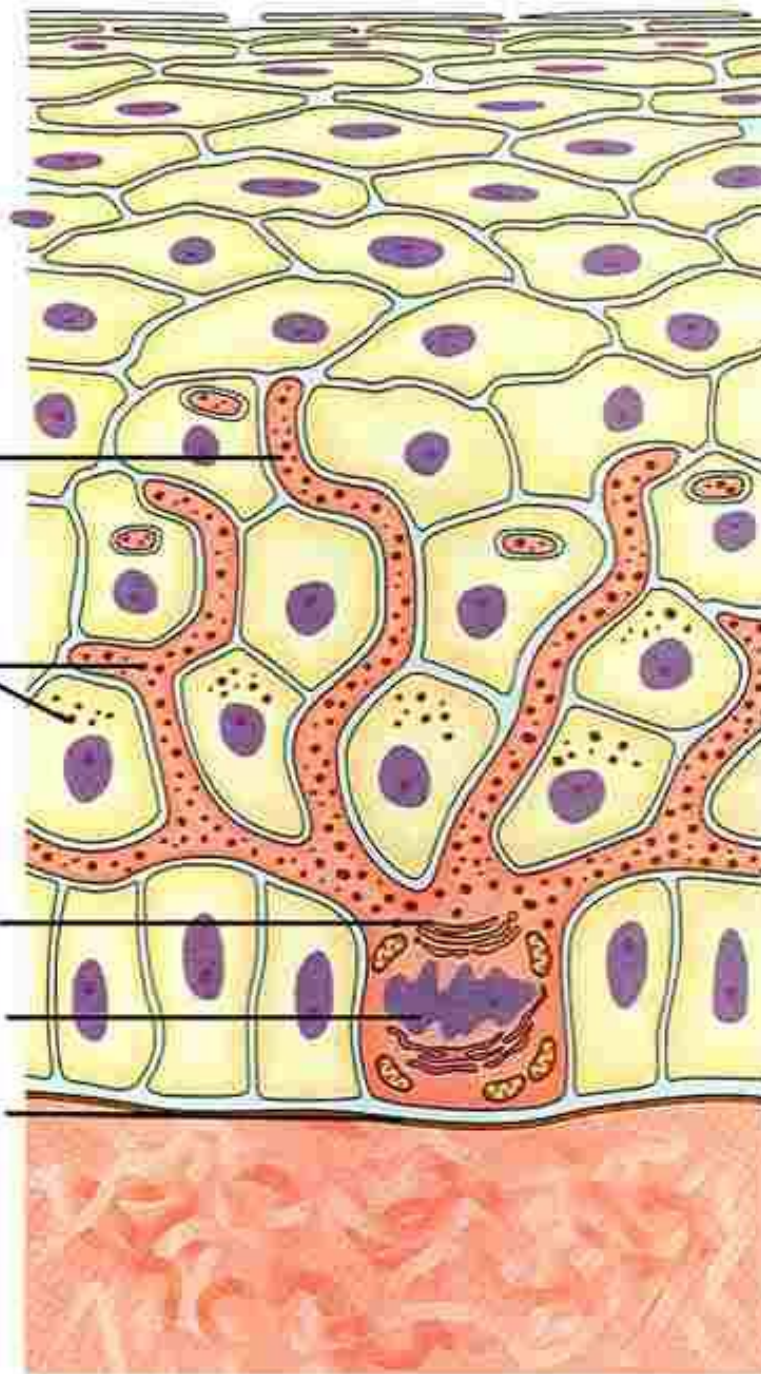
Cellular Extension  
of  
Melanocyte

Melanin  
Granules

Golgi Apparatus

Melanocyte Nucleus

Basal Lamina



Epidermis

Dermis

# Melanocytes

- When skin is exposed to the sun, melanocytes produce more melanin to protect the skin from the damaging effects of the ultraviolet (UV) radiation in sunlight.
- The melanin is passed to other epidermal cells, and the result is tanning, or in some people, the formation of patches of melanin called freckles.



# Albinism

- A hereditary trait characterized by the lack of ability to produce melanin.
- Individuals with this disorder lack pigment not only in the skin, but also in the hair and eyes.





# Carotene

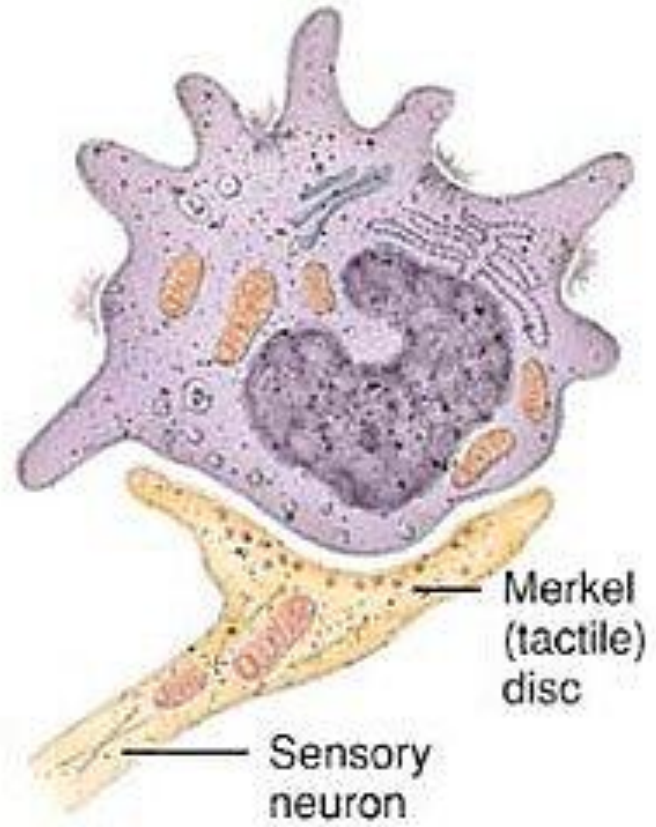
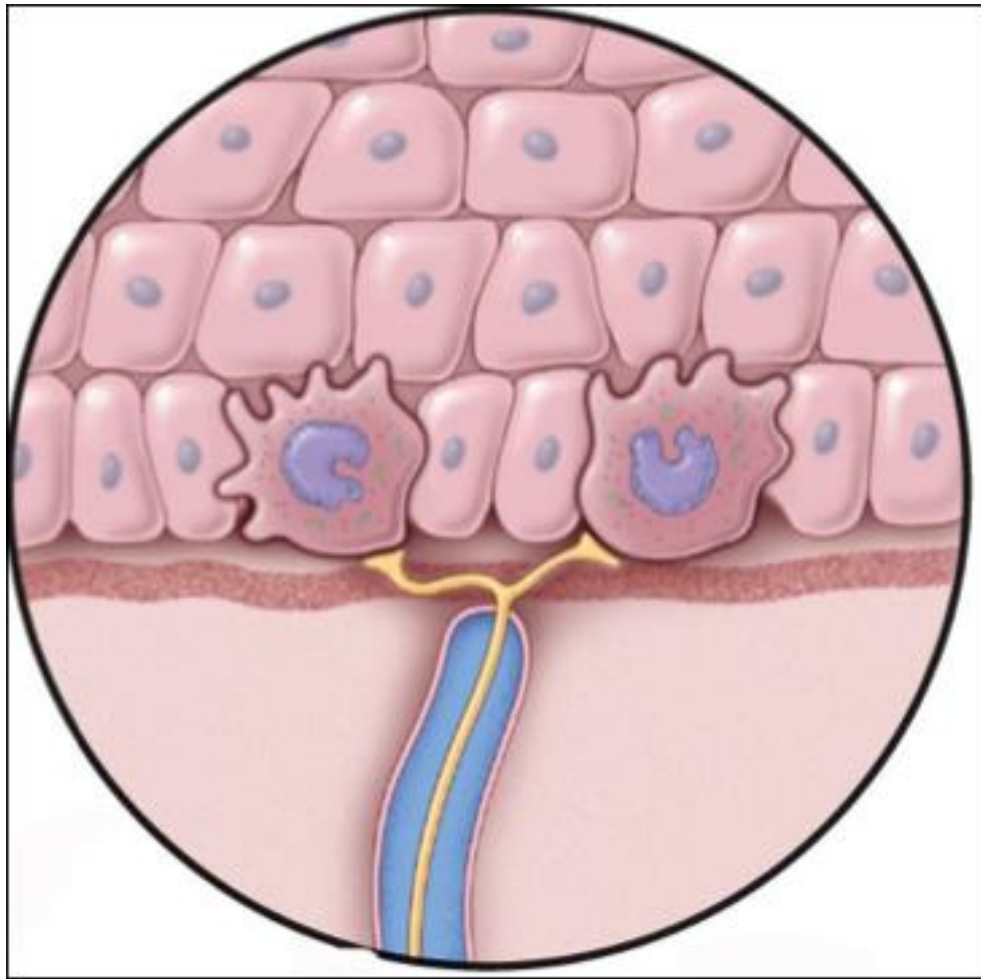
- **Yellow to orange pigment found in certain plant products such as carrots.**
- **Tends to accumulate in the stratum corneum and in the tissue of the hypodermis**
- **Color most obvious in the palms and soles,** where the stratum corneum is thickest (example: the skin of the heel).
- **Most intense when large amounts of carotene-rich foods are eaten**



# Merkel Cells

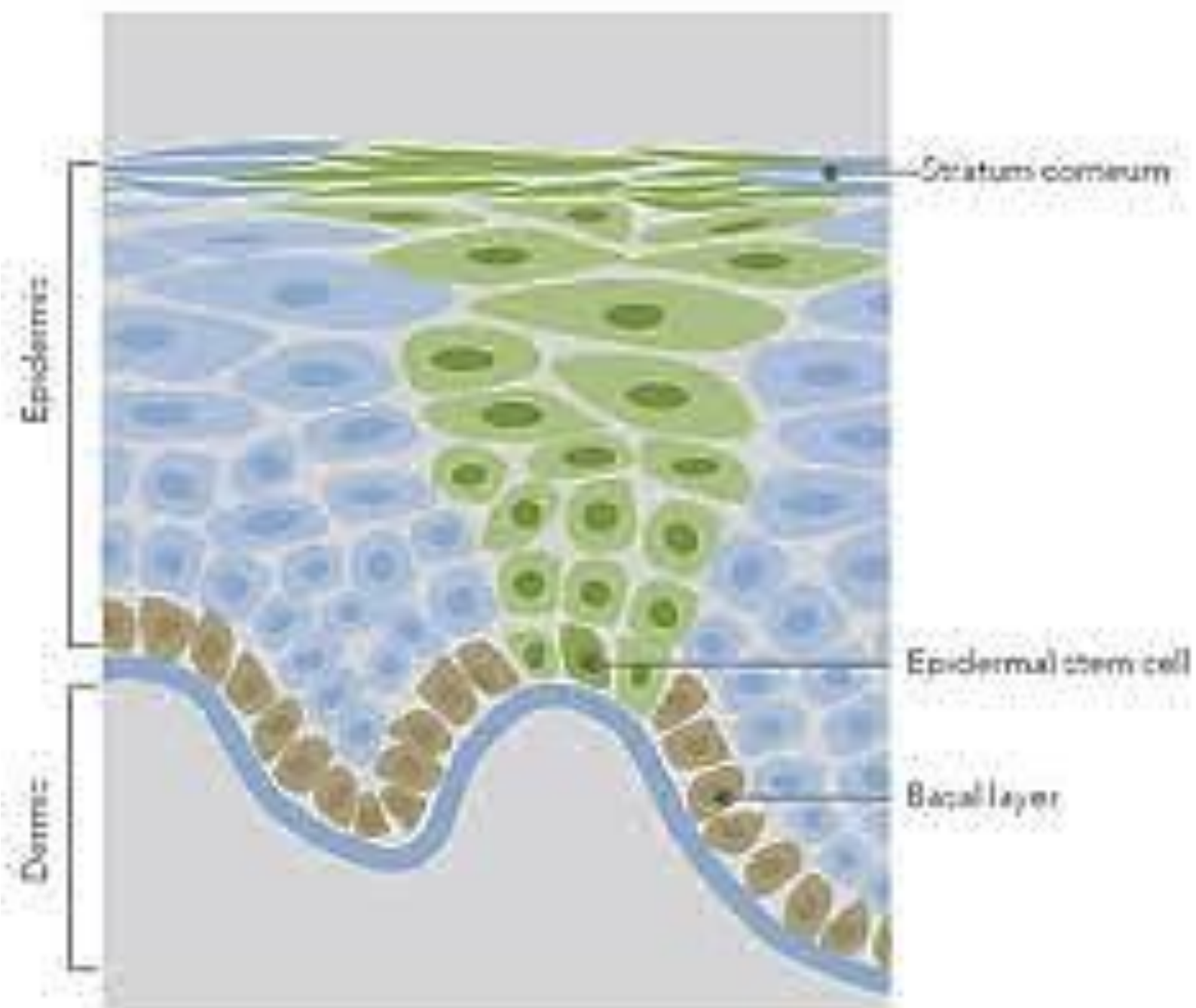
- Present at the epidermal-dermal junction
- Shaped like a spiky hemisphere
- Intimately associated with a disc like sensory nerve ending:
  - This combination is called a **Merkel disc**
  - *Functions as a sensory receptor for touch*





# Stem cells

- Stem cells can be defined as cells that have an unlimited capacity for self-renewal and the ability to generate daughter cells that undergo terminal differentiation.
- Basal keratinocytes are stem cells; however, not all dividing basal keratinocytes are stem cells.



# Stem cells

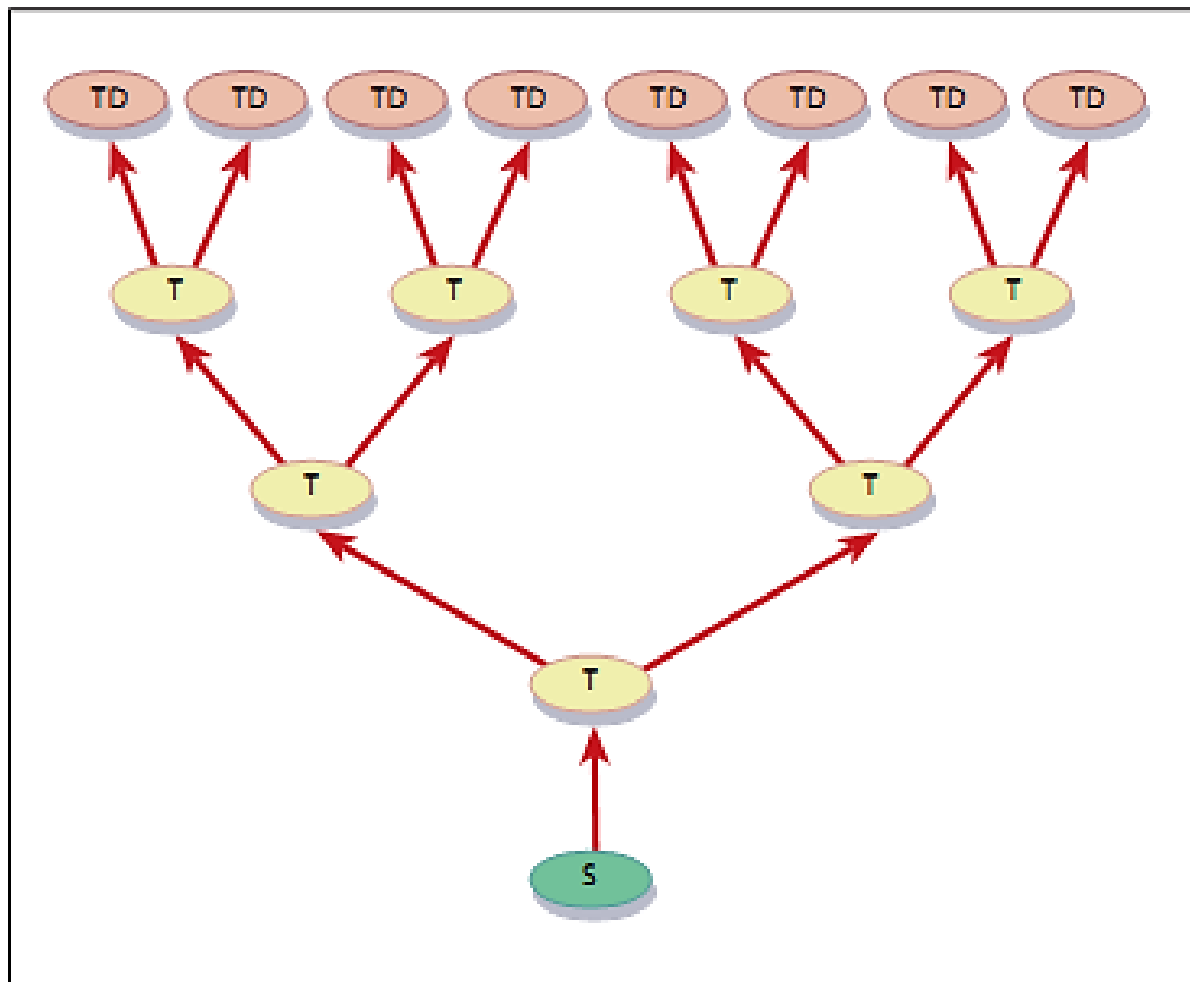
- Although morphologically similar to other keratinocytes, stem cells are, to some extent, associated with a profile of particular chemical, molecular and biological characteristics (increased  $\beta 1$  integrin expression).

# Stem cells

- Stem cells in the bulge region have the capacity to migrate and to differentiate into diverse lineages (e.g. outer root sheath [ORS], IRS, hair shaft, sebocytes and interfollicular epidermis).
- The precise lineage of terminal differentiation is governed by several local environmental cues.

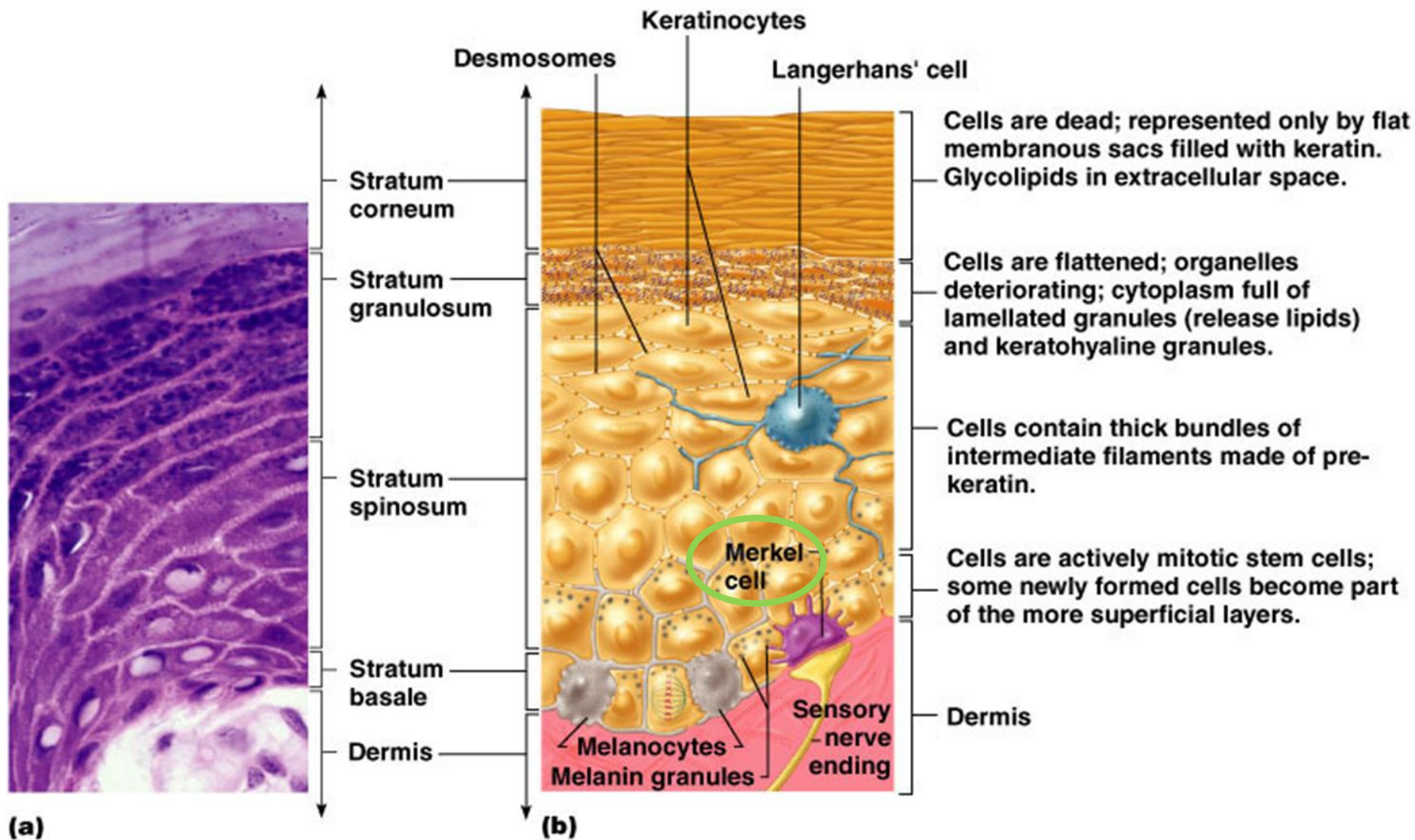
# Stem cells

- The mechanisms that control exit from the stem cell compartment are incompletely understood, but clearly several molecular networks and signalling pathways are important in balancing epidermal growth and differentiation.
- Key components include NF- $\kappa$ B, and  $\beta$ 1 integrin.



Keratinocyte stem cell and transient amplifying cell division in human skin. Transient amplifying cells (T) are capable of increasing the number of keratinocytes that undergo terminal differentiation (TD) following a single stem cell (S) division. In this example, one stem cell division has resulted in eight terminally differentiated cells.







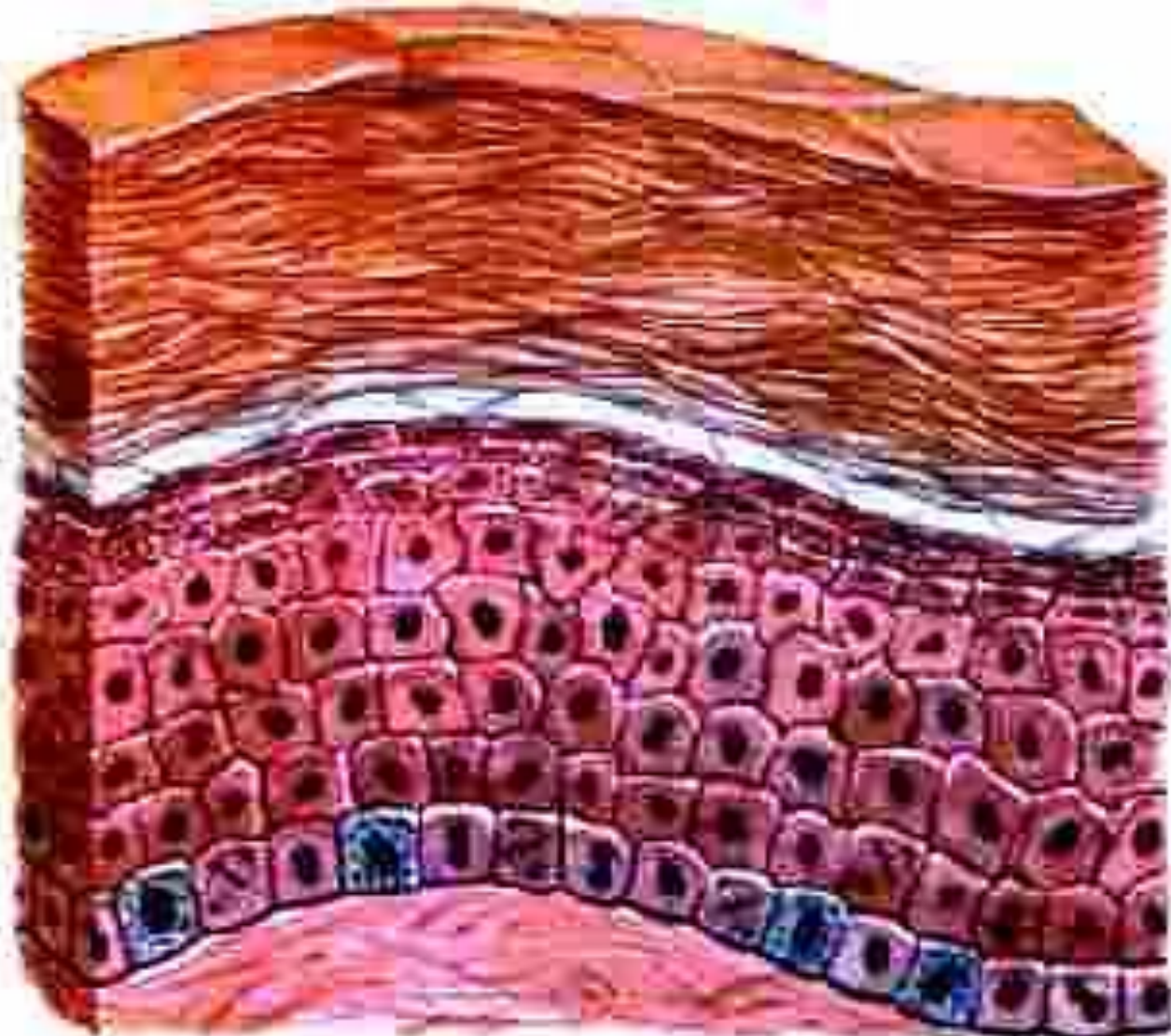
Stratum corneum

Stratum lucidum

Stratum granulosum

Stratum spinosum

Stratum basale



- **Stratum Basale**

- The basal cells of the stratum basale lie just superior to the dermis and are constantly dividing and producing new cells that are pushed to the surface of the epidermis in two to four weeks.
- As the cells move away from the dermis, they get progressively farther away from the blood vessels in the dermis.

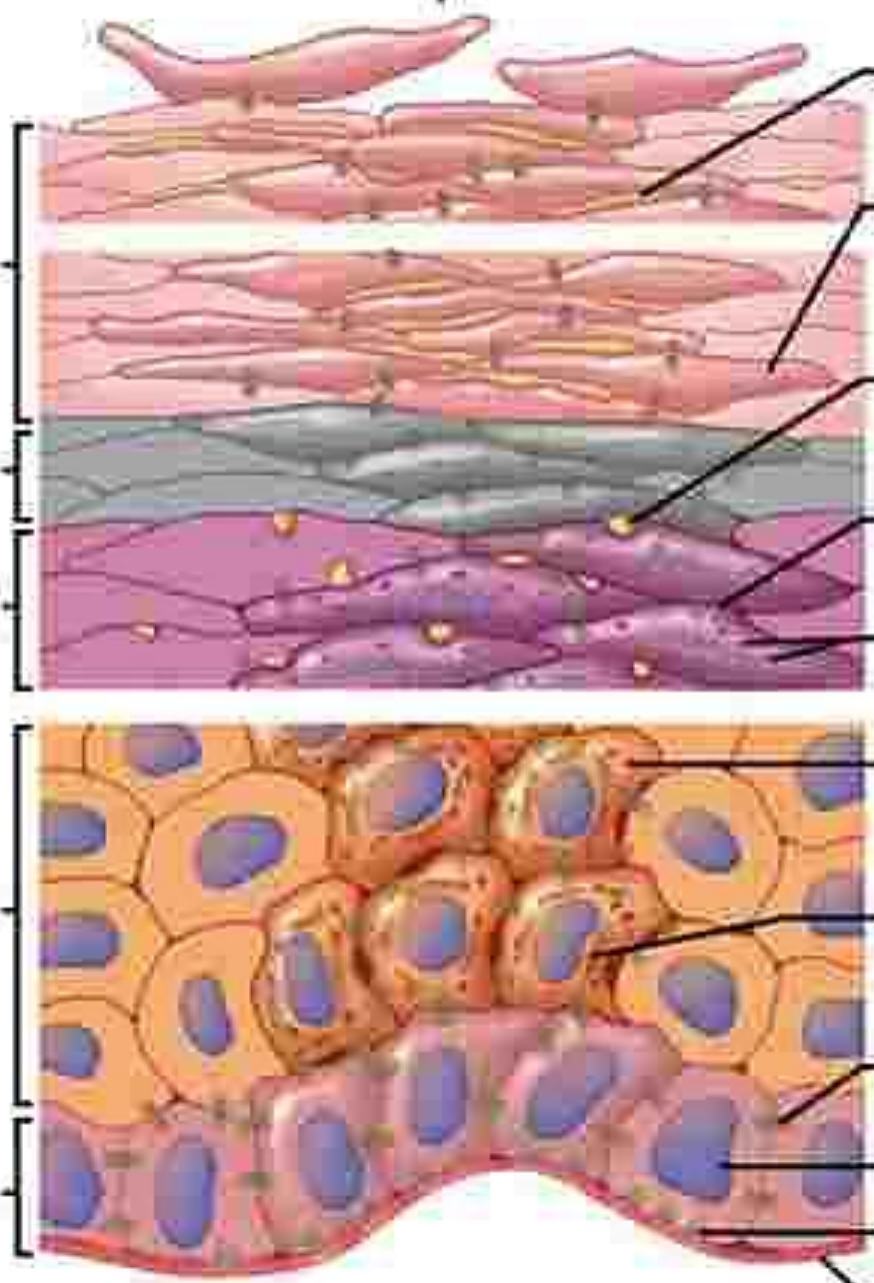
- **Stratum Basale**

- Because these cells are not being supplied with nutrients and oxygen (the epidermis itself lacks blood vessels), they eventually die and are sloughed off.



# Superficial

- 5. Stratum corneum**  
Dead cells with a hard protein envelope; the cells contain keratin and are surrounded by lipids.
- 4. Stratum lucidum**  
Dead cells containing dispersed keratohyalin.
- 3. Stratum granulosum**  
Keratohyalin and a hard protein envelope form; lamellar bodies release lipids; cells die.
- 2. Stratum spinosum**  
Keratin fibers and lamellar bodies accumulate.
- 1. Stratum basale**  
Cells divide by mitosis and some of the newly formed cells become the cells of the more superficial strata.



- Intercellular lipids
- Keratin
- Lamellar body releases lipids
- Protein envelope
- Keratohyalin granules
- Lipid-filled lamellar body
- Keratin fiber
- Desmosome
- Nucleus
- Hemidesmosome
- Basement membrane

Deep

## • **Stratum Corneum**

- As cells are pushed toward the surface of the skin, they become flat and hard, forming the tough, uppermost layer of the epidermis, the stratum corneum.
- 
- Hardening is caused by keratinization, the cellular production of a fibrous, waterproof protein called keratin.



# Superficial

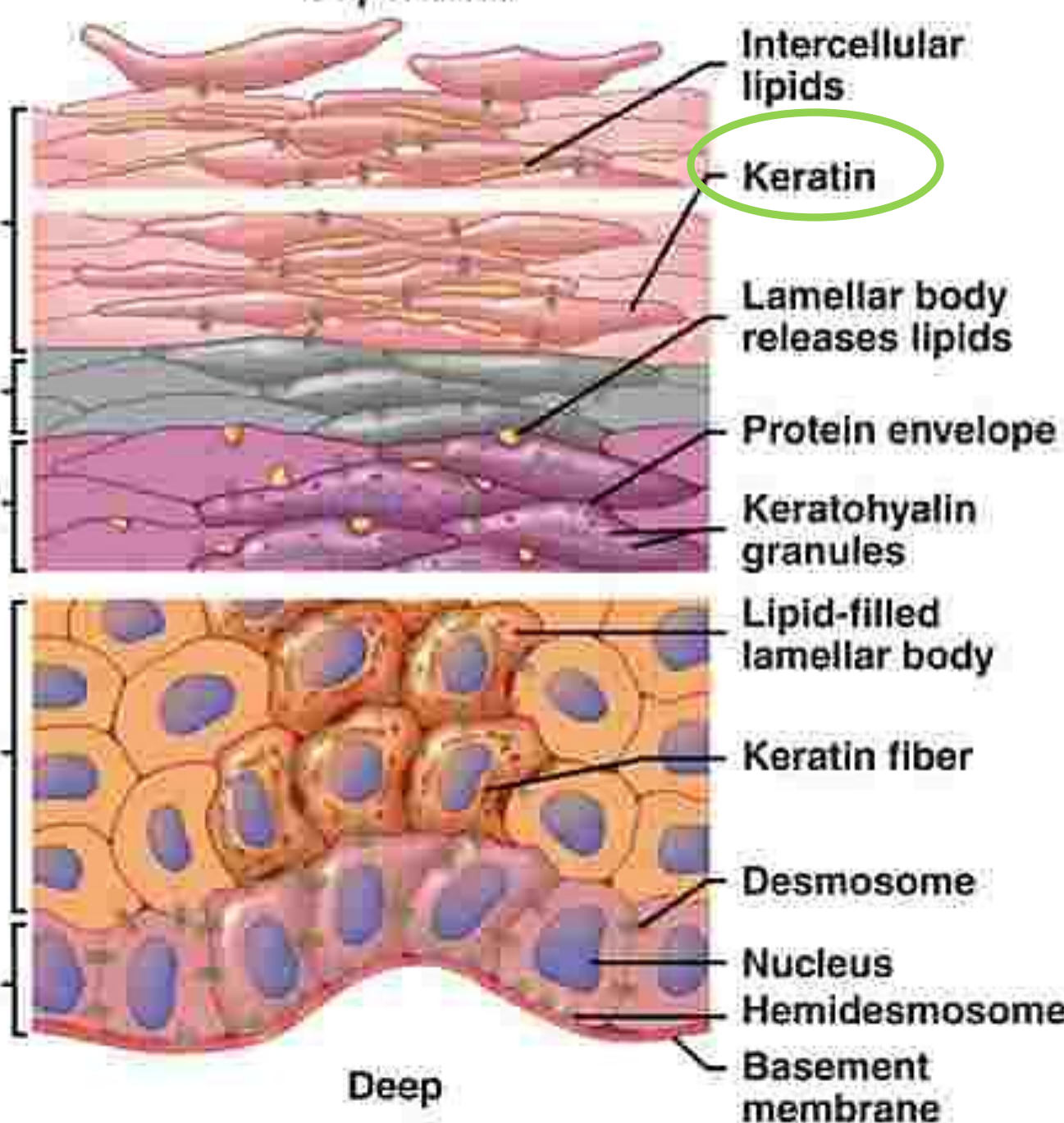
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Deep

- **Stratum Corneum**

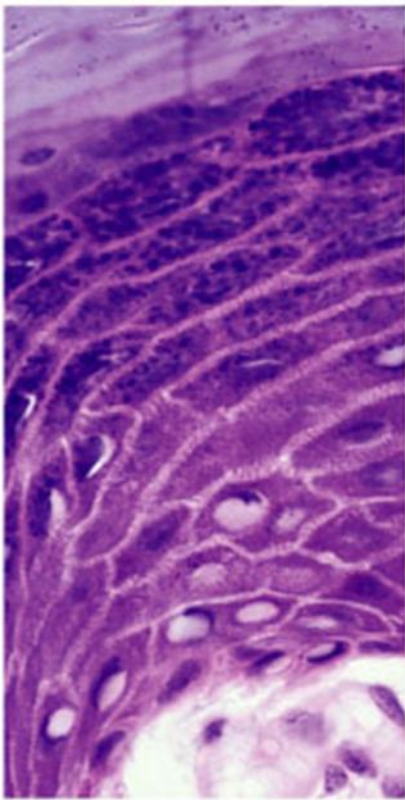
- Over much of the body, keratinization is minimal, but the palms of the hands and the soles of the feet normally have a particularly thick outer layer of dead, keratinized cells.



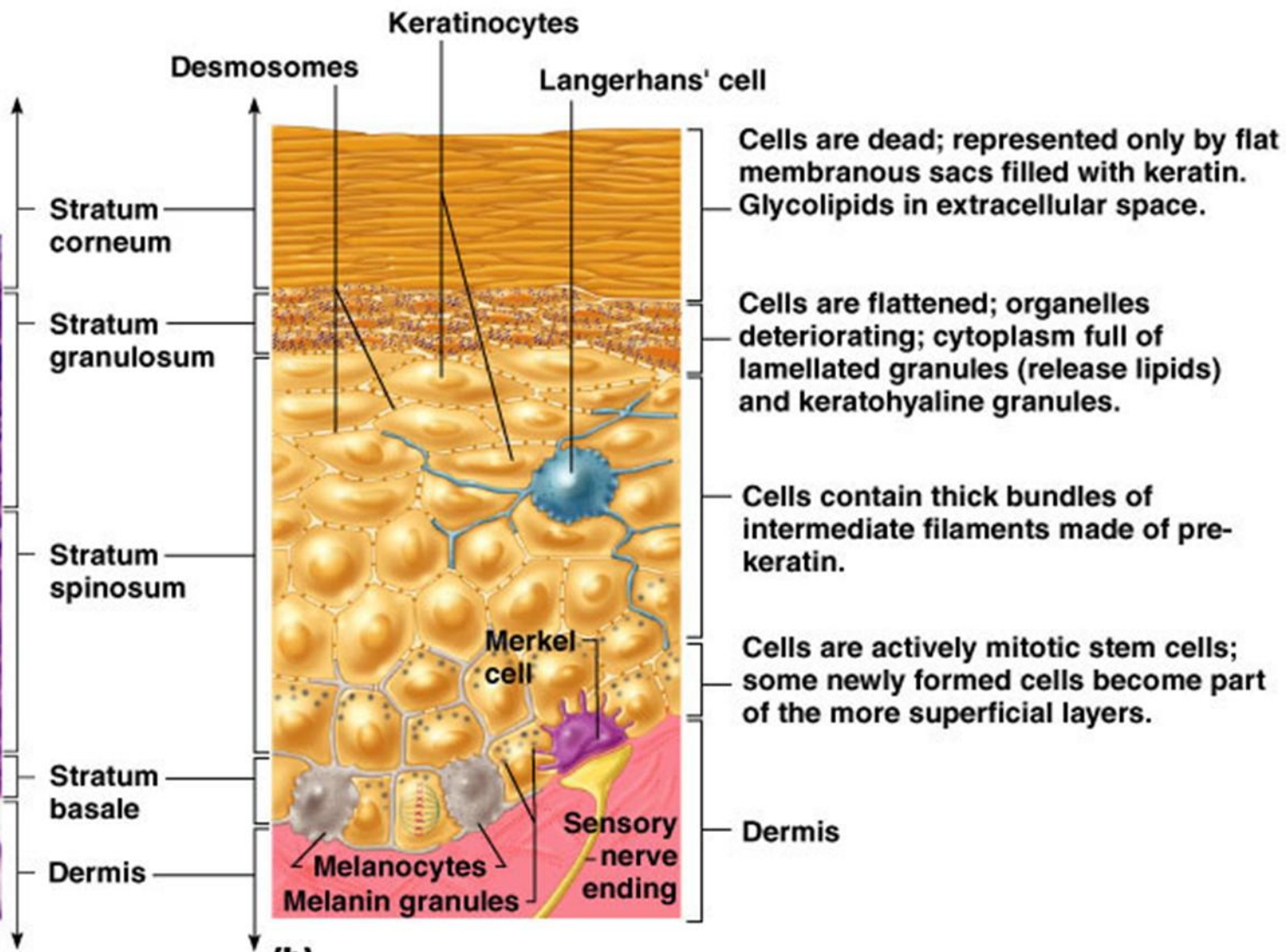


## • **Stratum Corneum**

- The waterproof nature of keratin protects the body from water loss and water gain.
- The stratum corneum also serves as a mechanical barrier against microbe invasion.



**(a)**



**(b)**

# Turnover time in the epidermis

- Amount of time for the whole cell population to replace itself (regeneration time or replacement time).
- This depends both on the time taken for individual cells to divide, cell cycle, and the proportion of basal cells dividing the growth fraction

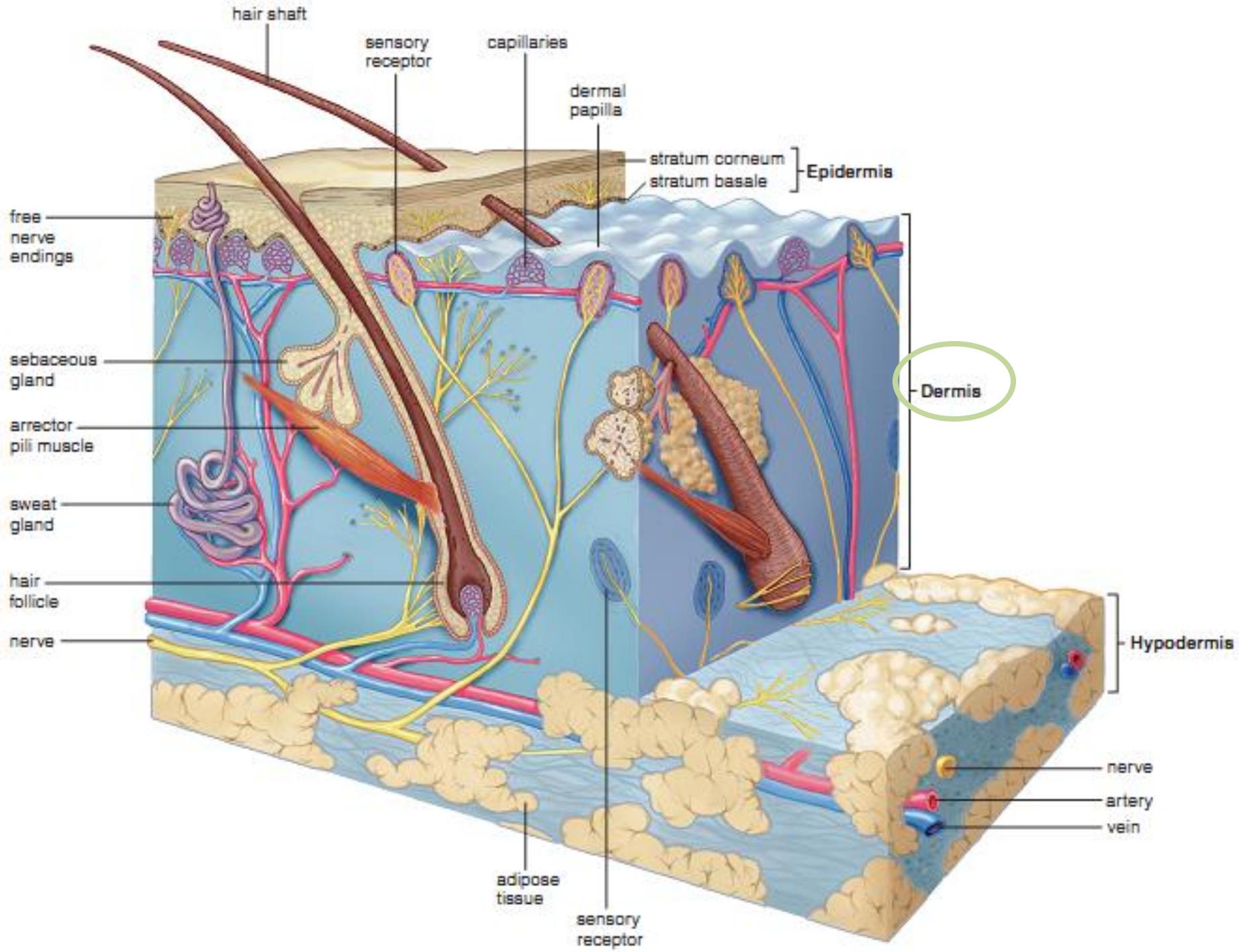
# Turnover time in the epidermis

- **The growth fraction** is the proportion of basal cells that are proliferative at any one time.
- High proliferative rates can be achieved by a shorter cell cycle, or a higher proportion of proliferating cells, or both.

# Turnover time in the epidermis

- **The epidermal turnover time, or transit time** represents the time taken for a cell to pass from basal layer to the surface of the skin, comprising passage through the living compartment and through the non-viable compartment to the surface.
- In normal skin, the total time is **52–75 days**.





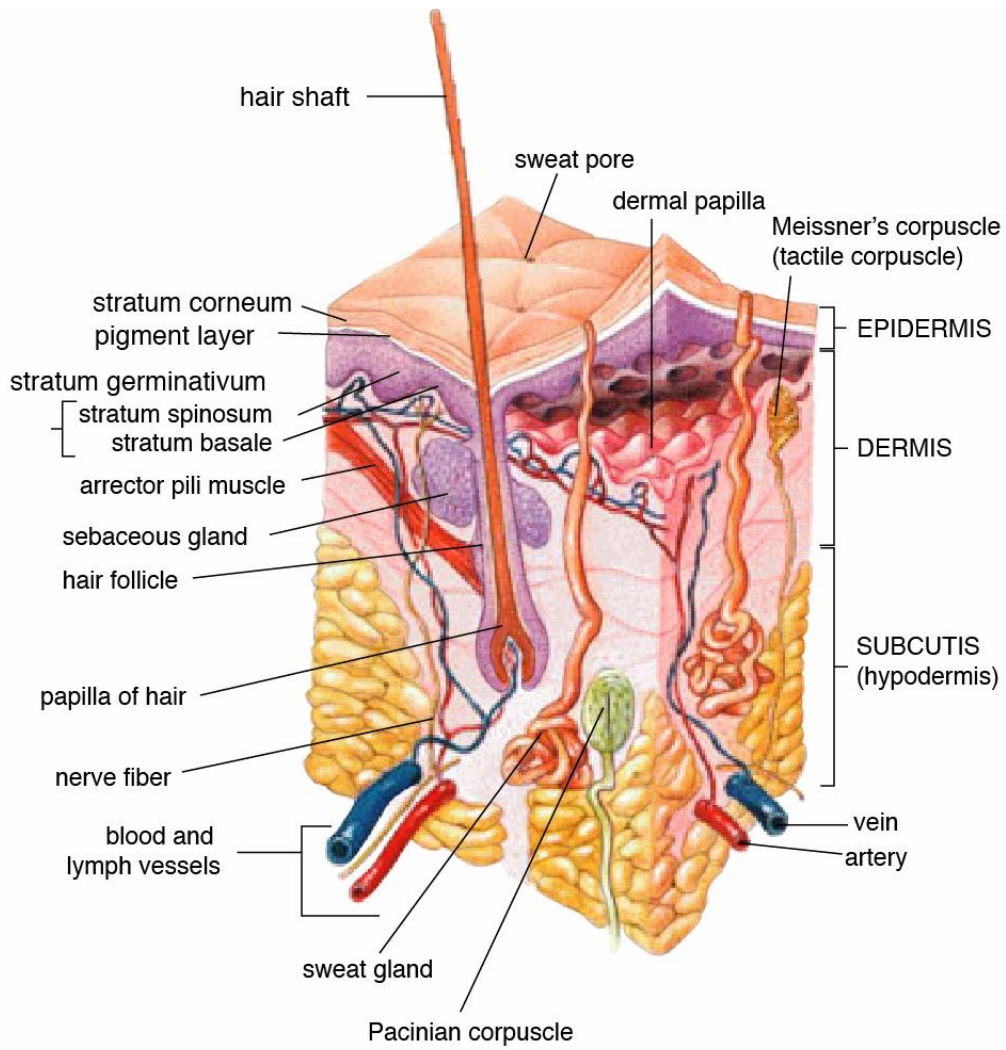
# Dermis

- The dermis, a deeper and thicker region than the epidermis, is composed of dense irregular connective tissue.
- The upper layer of the dermis has fingerlike projections called dermal papillae.

# Dermis

- Dermal papillae project into and anchor the epidermis. In the overlying epidermis, dermal papillae cause ridges, resulting in spiral and concentric patterns commonly known as “fingerprints.”
- The function of the epidermal ridges is to increase friction and thus provide a better gripping surface.





# Dermis

Because they are unique to each person, fingerprints and footprints can be used for identification purposes.

# Dermis

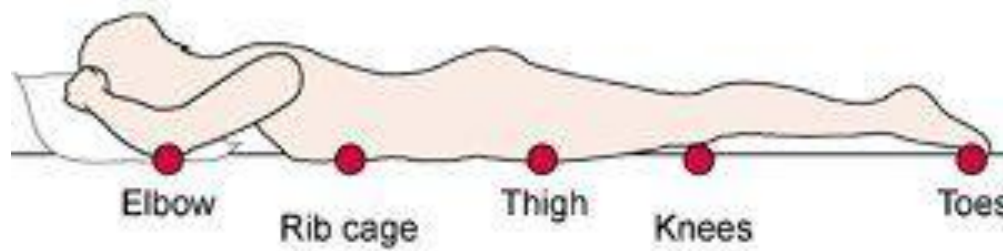
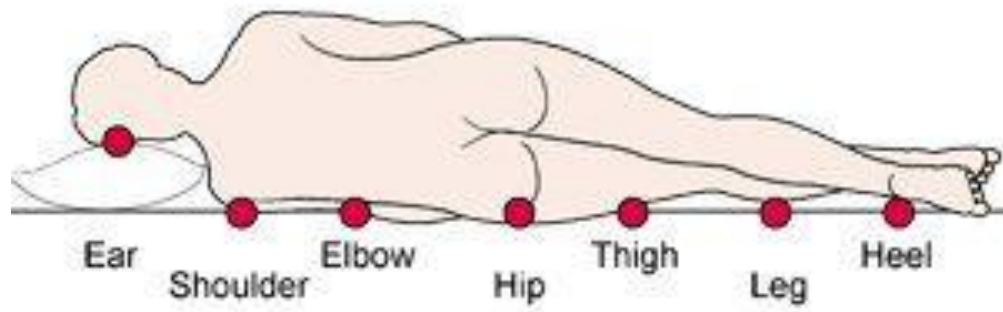
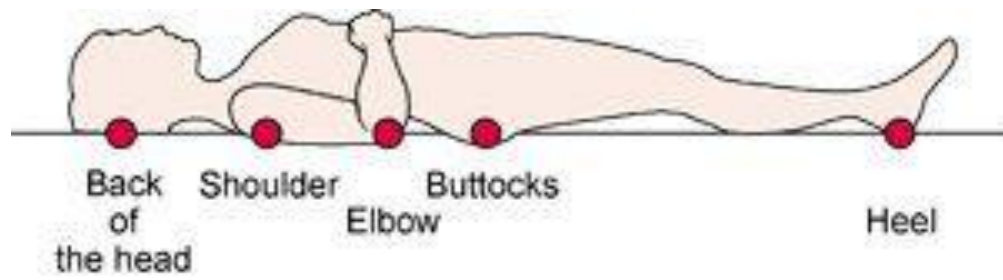
- The dermis contains:
- **The collagenous fibers** are flexible but offer great resistance to over stretching; they prevent the skin from being torn.
- **The elastic fibers** stretch to allow movement of underlying muscles and joints, but they maintain normal skin tension.

# Dermis

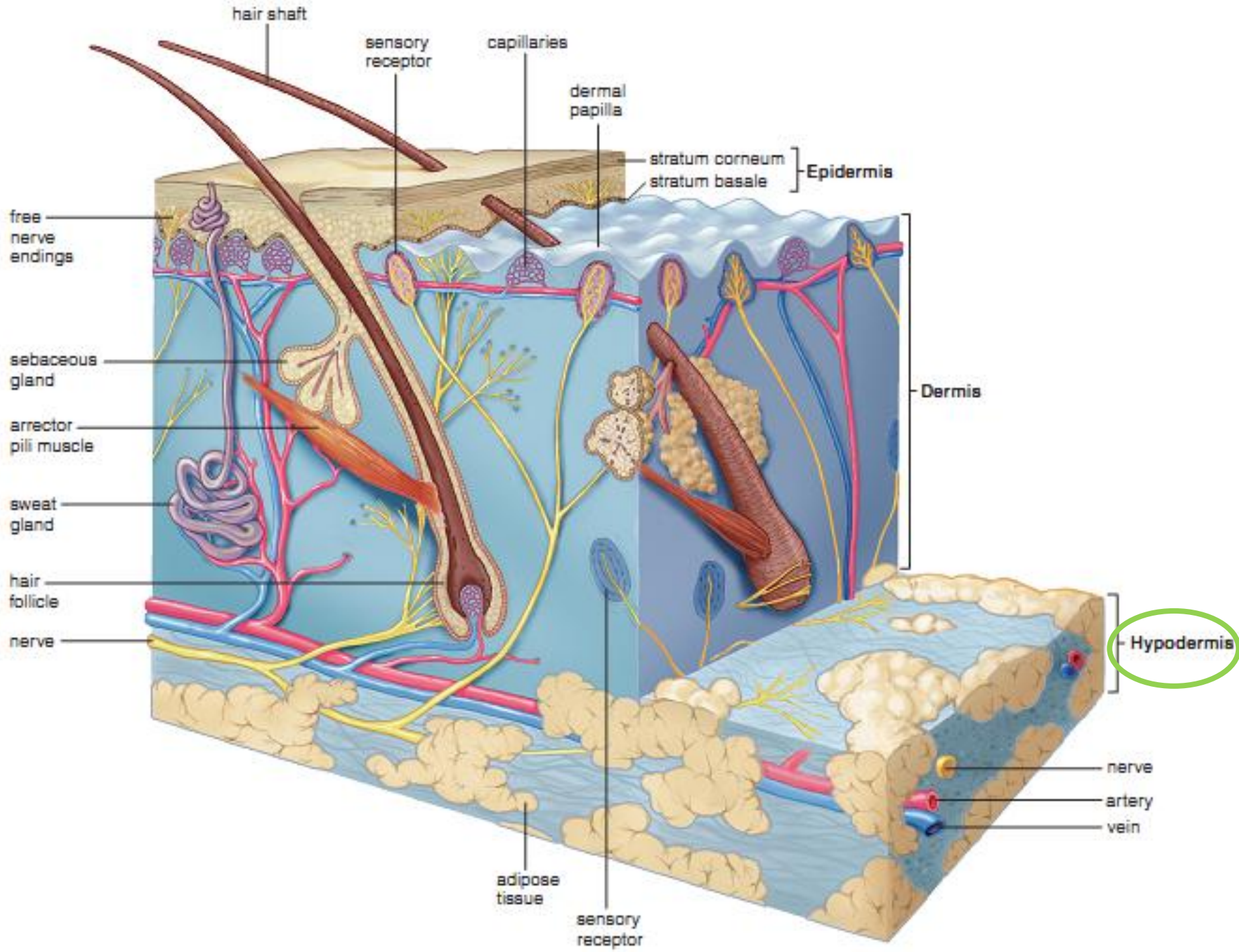
- The dermis also contains blood vessels that nourish the skin.
- Blood rushes into these vessels when a person blushes; blood is reduced in them when a person turns cyanotic, or “blue.”

# Dermis

- Sometimes, blood flow to a particular area is restricted in bedridden patients, and consequently they develop decubitus ulcers (bedsores).
- These can be prevented by changing the patient's position frequently and by massaging the skin to stimulate blood flow.







# Hypodermis

- Hypodermis, or subcutaneous tissue, lies below the dermis.
- From the names for this layer, we get the terms subcutaneous injection, performed with a hypodermic needle



# Hypodermis

- The hypodermis is composed of loose connective tissue, including adipose (fat) tissue.
- Fat is an energy storage form that can be called upon when necessary to supply the body with molecules for cellular respiration.

# Hypodermis

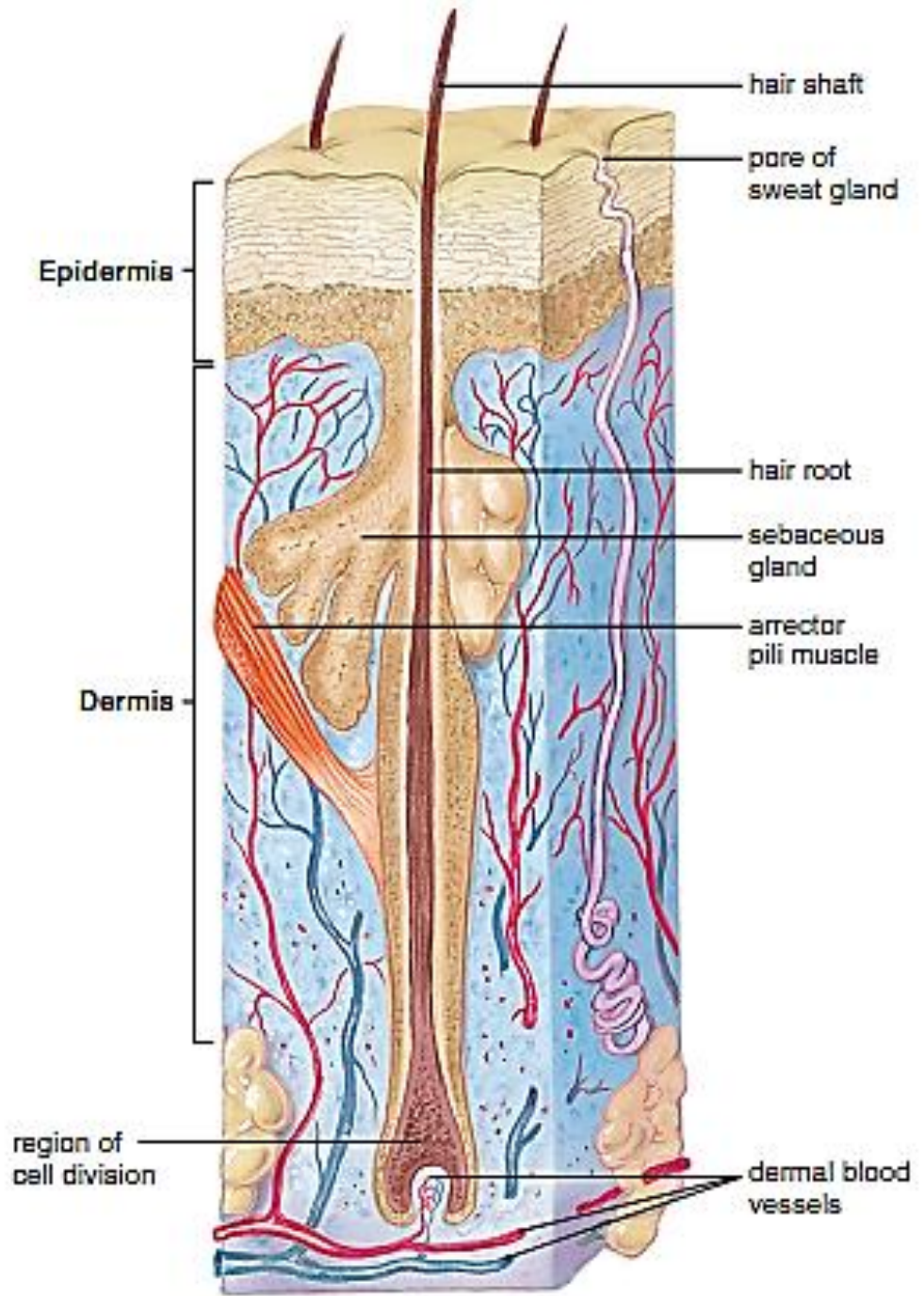
- Adipose tissue also helps insulate the body. A well-developed hypodermis gives the body a rounded appearance and provides protective padding against external assaults.
- Excessive development of adipose tissue in the hypodermis layer results in obesity.

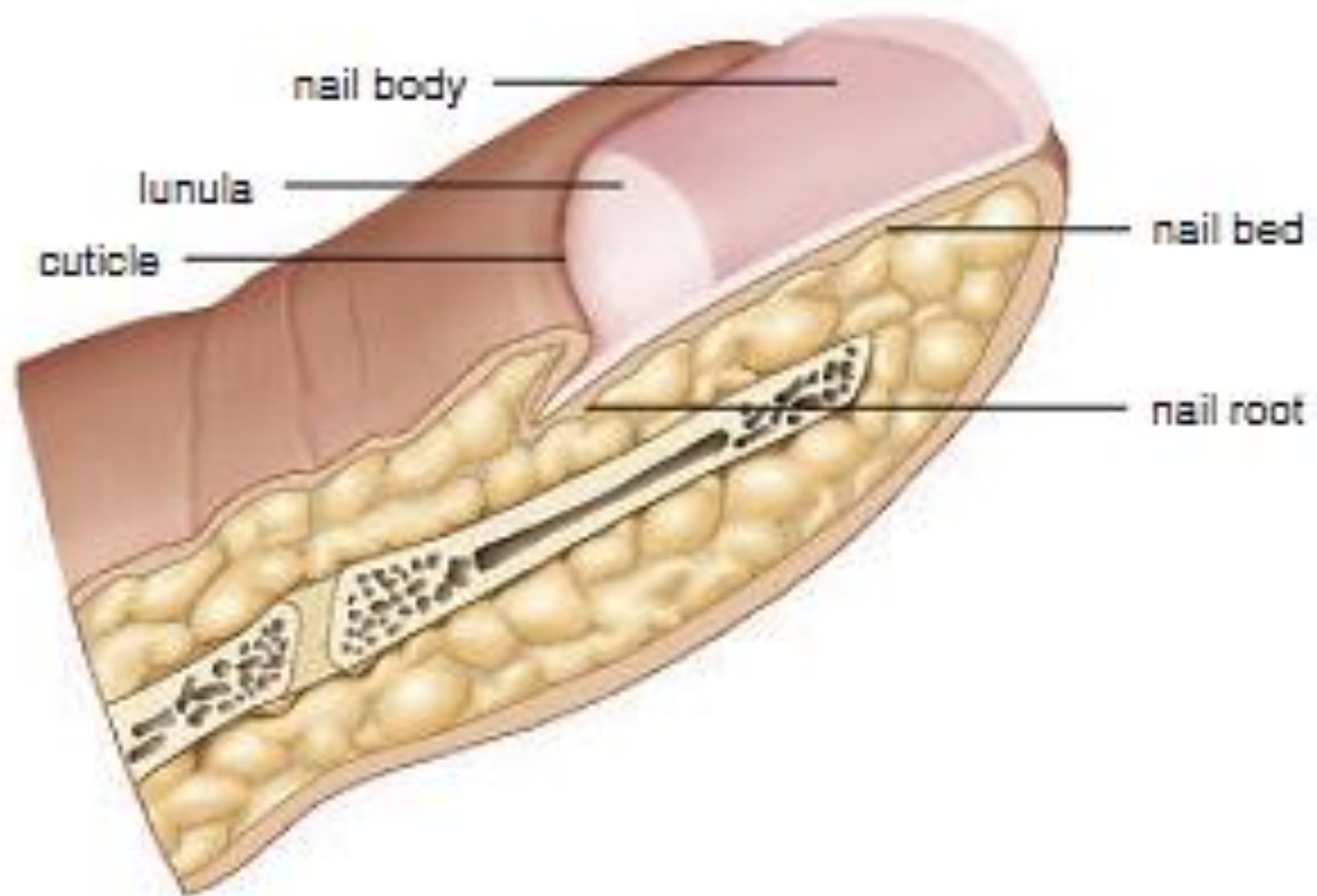
# **Accessory Structures of the Skin**

- **Hair and Nails**
- **Glands:**
  - Sweat Glands**
  - Sebaceous Glands**
  - Mammary Glands**

# Accessory Structures of the Skin

- **Hair and Nails**
- **Hair** is found on all body parts except the palms, soles, lips, nipples, and portions of the external reproductive organs.
- **Nails** grow from special epithelial cells at the base of the nail in the region called the **nail root**. These cells become keratinized as they grow out over the nail bed.





# Accessory Structures of the Skin

- **Glands:**

- **Sweat Glands:**

Present in all regions of the skin.

Two types of sweat glands: Apocrine glands and eccrine glands open onto the surface of the skin.



# Eccrine Sweat Glands

- **Also called merocrine sweat glands**
- **Abundant** on the palms, soles of feet, and forehead
- **Simple, coiled, tubular gland** **Secretory part lies coiled in the dermis:**
  - The duct extends to open in a funnel-shaped pore at the skin surface
- **Secretion commonly called sweat is a:**
  - **Hypotonic filtrate** (lower osmotic pressure than a reference) of the blood that passes through the secretory cells of the sweat glands and is released by exocytosis
  - **99% water**, with some salts (mostly sodium chloride)
  - **Vitamin C**
  - **Antibodies**
  - **Dermicidin**: microbe-killing peptide
  - **Traces of metabolic waste** ( urea, uric acid, ammonia)
  - **Lactic acid**: chemical that attracts mosquitoes
  - **pH between 4-6**

# Eccrine Sweat Glands

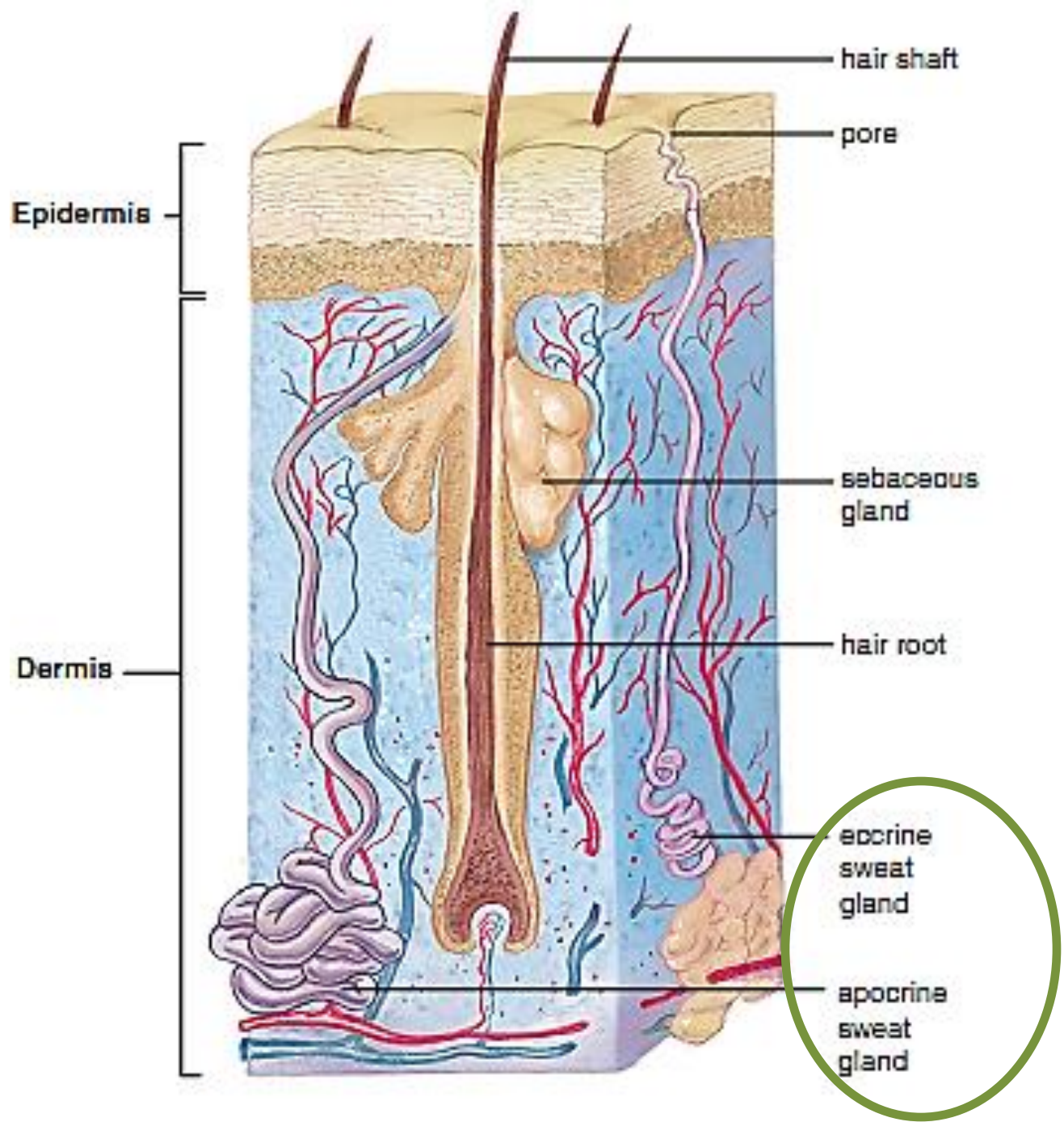
- **Sweating is regulated by the sympathetic nervous system**
  - **Major role is to prevent overheating of the body**
    - **Heat-induced sweating** begins on the forehead and then spreads inferiorly over the remainder of the body
    - **Emotionally induced sweating—so-called “cold sweat”** brought on by fright, embarrassment, or nervousness—begins on the palms, soles, and axillae (armpits) and then spreads to other body areas

# Apocrine Sweat Glands

- Largely **confined to the axillary and anogenital areas**
- **Larger** than eccrine glands
- **Ducts empty into hair follicles**
- Secretion contains **the same basic components as true sweat, plus fatty substances and proteins**
  - Quite **viscous** and **milky or yellowish color**
  - **Odorless:**
    - **BUT, *when its organic molecules are decomposed by bacteria on the skin, it takes on a musky and generally unpleasant odor (BODY ODOR)***

# Apocrine Sweat Glands

- **Little role in thermoregulation**
- **Role not completely understood**
  - **BUT**, they are activated by sympathetic nerve fibers during pain and stress
- Because their activity is **increased by sexual foreplay**, and they enlarge and recede with the phases of a women's menstrual cycle, they **may be analogous to the sexual scent glands of other animals**



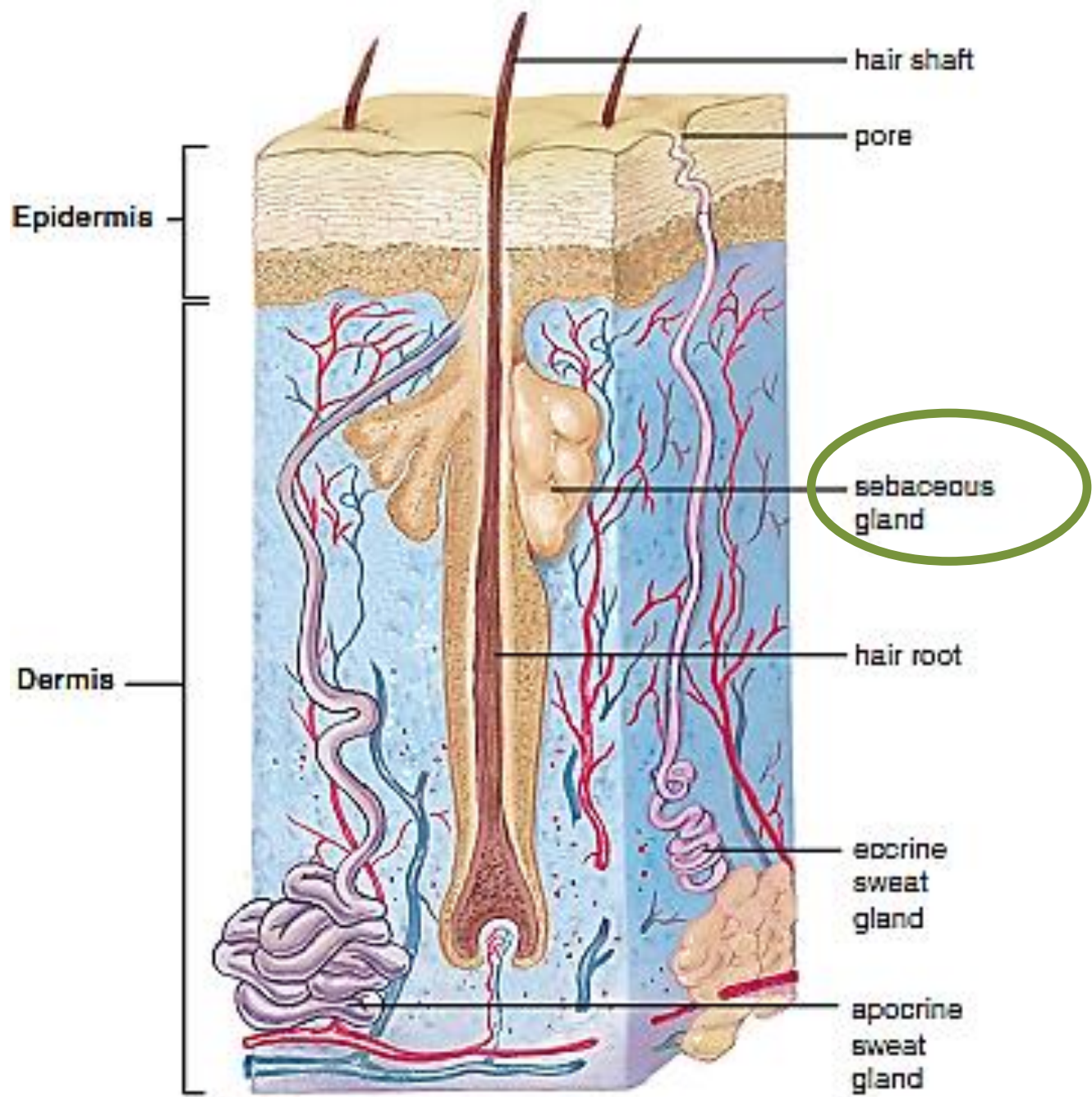
# Accessory Structures of the Skin

- **Glands:**

- **Sebaceous Glands**

Most sebaceous glands are associated with a hair follicle.

These glands secrete an oily substance called **sebum** that flows into the follicle and then out onto the skin surface and helps waterproof them.





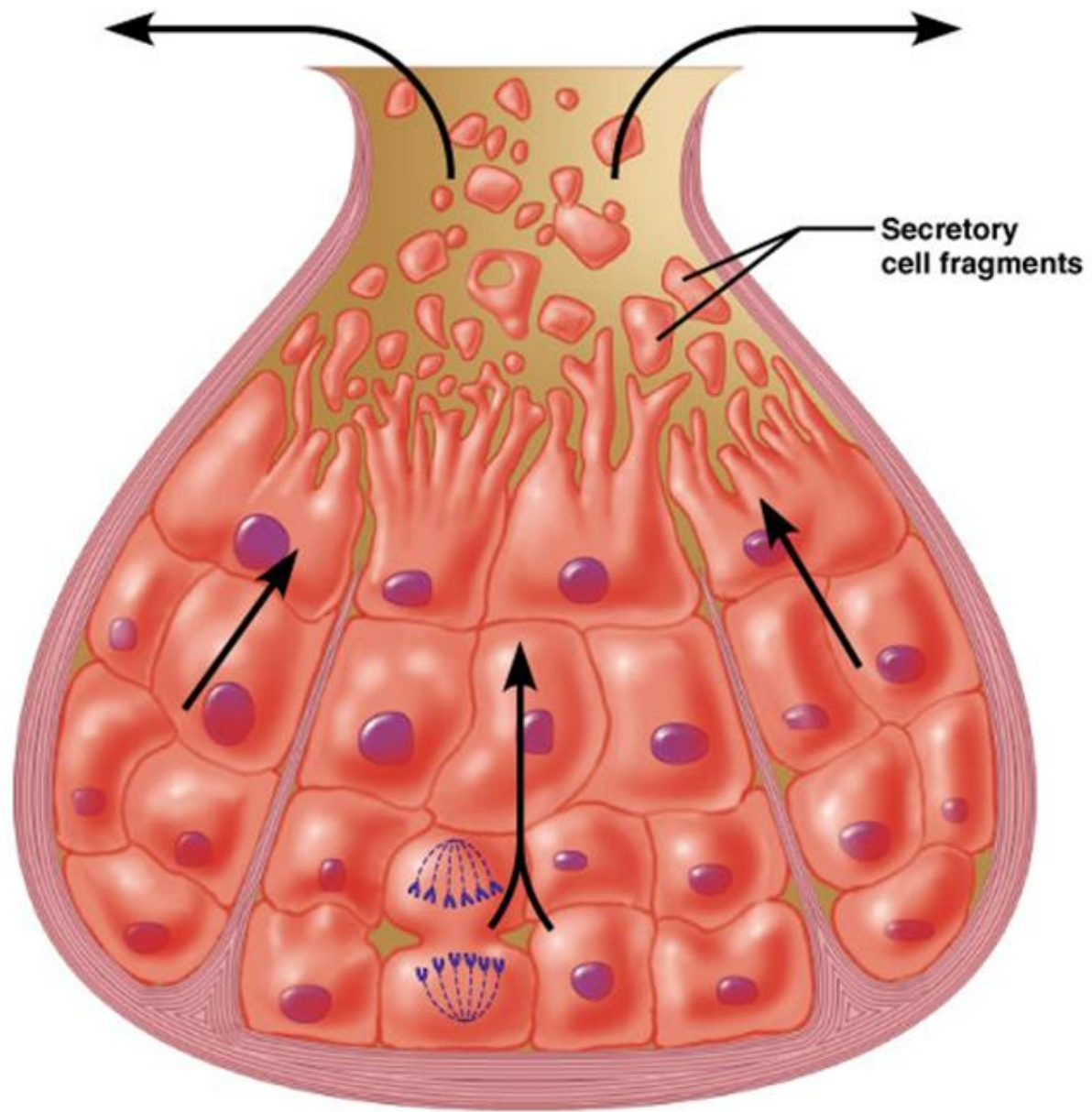
# Accessory Structures of the Skin

- Glands:

- Sebaceous Glands

- The central cells of the alveoli accumulate oily lipids until they become *so engorged that they burst, so functionally these glands are holocrine glands*

- The entire secretory cell ruptures, releasing secretions and dead cell fragments



# Accessory Structures of the Skin

- **Glands:**

- **Mammary Glands**

The mammary glands are located within the breasts.

A female breast contains 15 to 25 lobes, which are divided into lobules. Each lobule contains many alveoli.

# Accessory Structures of the Skin

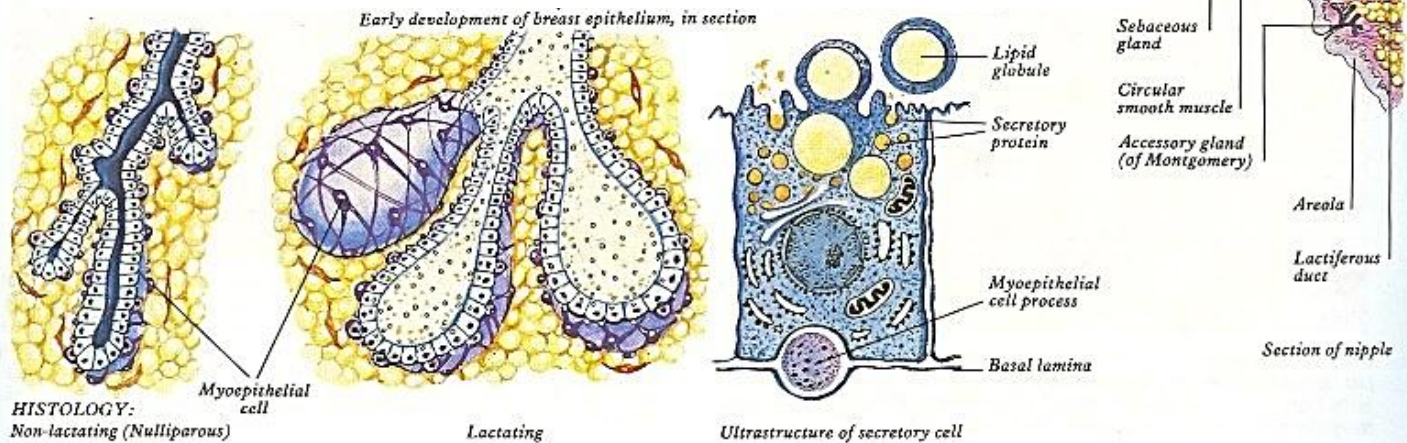
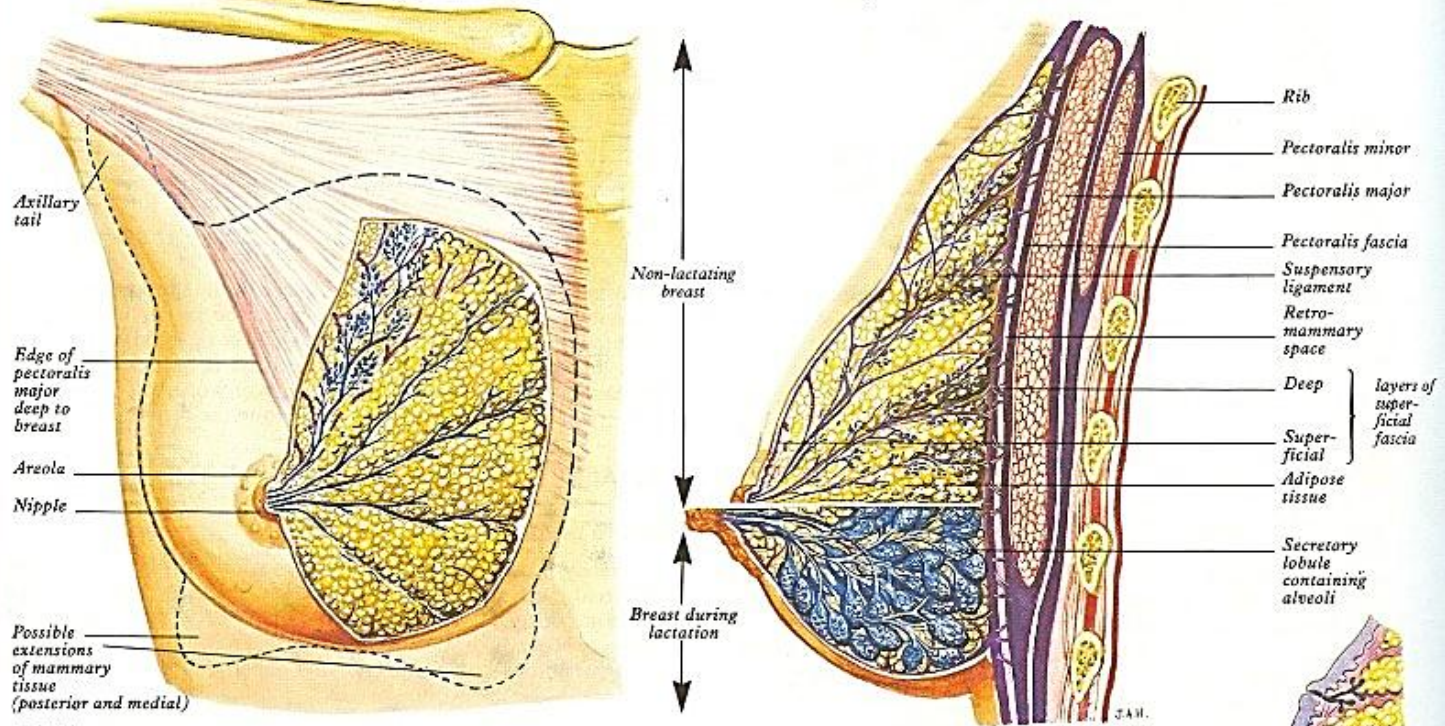
- **Glands:**

- **Mammary Glands**

When milk is secreted, the milk enters a duct that leads to the nipple.

Cells within the alveoli produce milk only after childbirth in response to complex hormonal changes occurring at that time.





# Functions Of The Skin

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- The functions of the skin assist the other systems of the body and other systems help the skin carry out these functions.



# Functions of the Skin

**1-Protective function**

**2-Skin helps regulate water loss**

**3-Skin produces vitamin D**

**4-Skin gathers sensory information**

**5-Skin helps regulate body temperature**

**6-Excretion**

# Functions of the Skin

## 1-Protective function

First and foremost, the skin forms a protective covering over the entire body, safeguarding underlying parts from physical trauma and pathogen invasion.

# Functions of the Skin

## 1-Protective function

The melanocytes in skin protect it from UV radiation and the skin's outer dead cells also help prevent bacterial invasion.

# Functions of the Skin

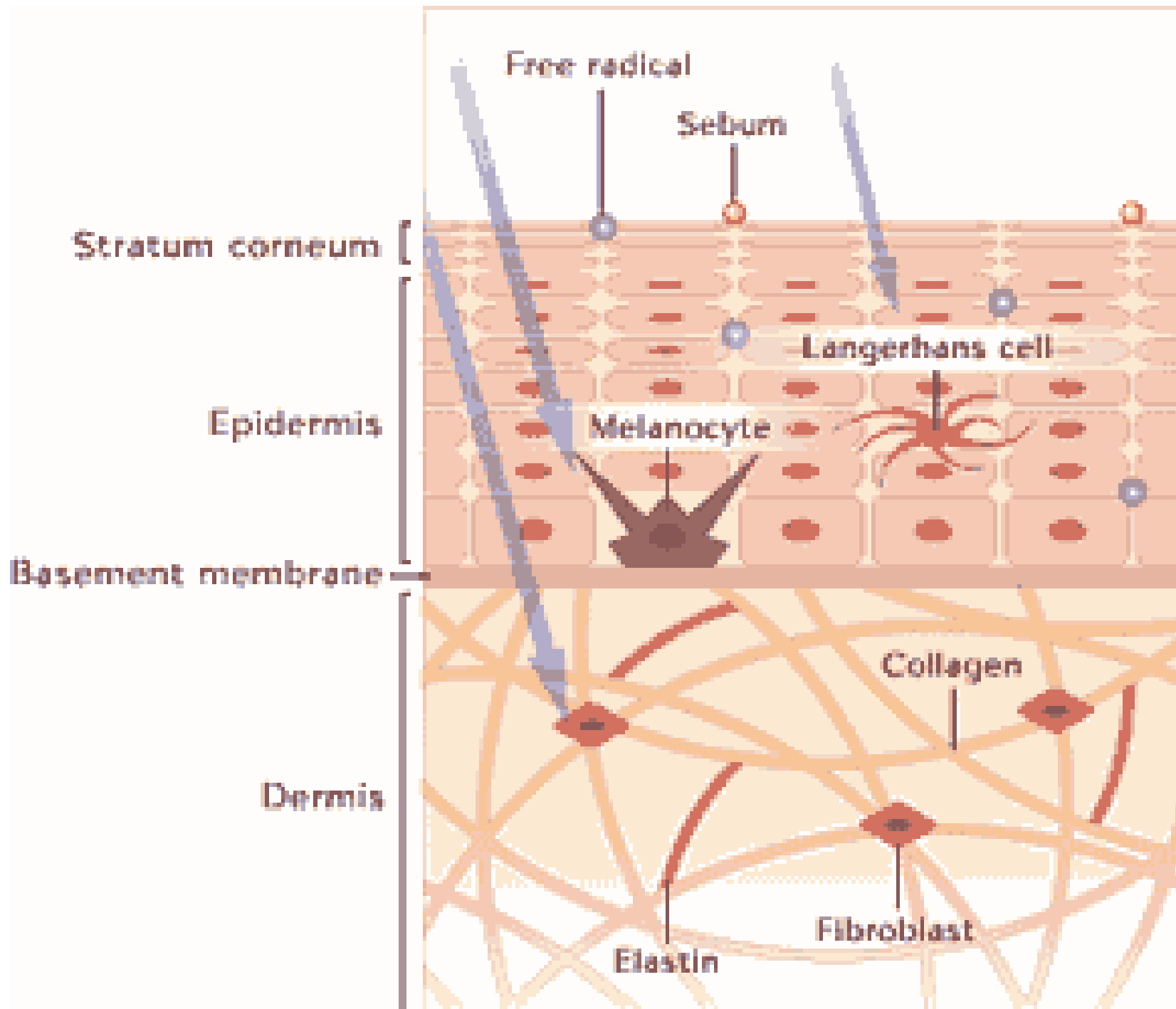
## 1-Protective function

The oily secretions from sebaceous glands are acidic, which retards the growth of bacteria.

# Functions of the Skin

## 1-Protective function

The Langerhans cells in the epidermis phagocytize pathogens and then alert the immune system to their presence.



# Functions of the Skin

## **2-Skin helps regulate water loss**

Since outer skin cells are dead and keratinized, the skin is waterproof, thereby preventing water loss.



# Functions of the Skin

## **2-Skin helps regulate water loss**

The skin's waterproofing also prevents water from entering the body when the skin is immersed.

# Functions of the Skin

## **2-Skin helps regulate water loss**

This function of the skin assists the urinary system, as do the sweat glands, which excrete some urea when sweating occurs.

# Functions of the Skin

## 3-Skin produces vitamin D

This function of skin is particularly useful to the digestive and skeletal systems. When skin cells are exposed to sunlight, the ultraviolet (UV) rays assist them in producing vitamin D.

# Functions of the Skin

## 3-Skin produces vitamin D

The cells contain a precursor molecule that is converted to vitamin D in the body after UV exposure; only a small amount of UV radiation is needed.

# Functions of the Skin

## 3-Skin produces vitamin D

Vitamin D leaves the skin and enters the liver and kidneys, where it is converted to a hormone called calcitriol.

# Functions of the Skin

## 3-Skin produces vitamin D

Calcitriol circulates throughout the body, regulating calcium uptake by the digestive system and both calcium and phosphorus metabolism in cells.

# Functions of the Skin

## 3-Skin produces vitamin D

Calcium and phosphorus are very important to the proper development and mineralization of the bones.



# Functions of the Skin

## 3-Skin produces vitamin D

Most milk today is fortified with vitamin D, which helps prevent the occurrence of rickets characterized especially by soft and deformed bones



**X ray of a child with rickets.**

# Functions of the Skin

## **4-Skin gathers sensory information**

The sensory receptors in the dermis specialized for touch, pressure, pain, hot, and cold are associated with the nervous system.

These receptors supply the central nervous system with information about the external environment.

# Functions of the Skin

## 4-Skin gathers sensory information

The fingertips contain the greatest number of touch receptors, allowing the fingers to be used for delicate tasks.

# Functions of the Skin

## 4-Skin gathers sensory information

The sensory receptors also account for the use of the skin as a means of communication between people. For example, the touch receptors play a major role in sexual arousal, which assists the reproductive system.

# Functions of the Skin

## 5-Skin helps regulate body temperature

When muscles contract and ATP is broken down, heat is released.

The skin plays an active role in whether this heat is conserved or released to the environment to maintain a body temperature of 36.2–37.7C

# Functions of the Skin

## **5-Skin helps regulate body temperature**

If body temperature starts to rise, the blood vessels in the skin dilate so that more blood is brought to the surface of the skin for cooling, and the sweat glands become active.



# Functions of the Skin

## **5-Skin helps regulate body temperature**

Sweat absorbs body heat, and this heat is carried away as sweat evaporates.

If the weather is humid, evaporation is hindered, but cooling can be assisted by a cool breeze

# Functions of the Skin

## **5-Skin helps regulate body temperature**

If the outer temperature is cool, the sweat glands remain inactive, and the blood vessels constrict so that less blood is brought to the skin's surface.

# Functions of the Skin

## **5-Skin helps regulate body temperature**

Whenever the body's temperature falls below normal, the muscles start to contract, causing shivering, which produces heat.

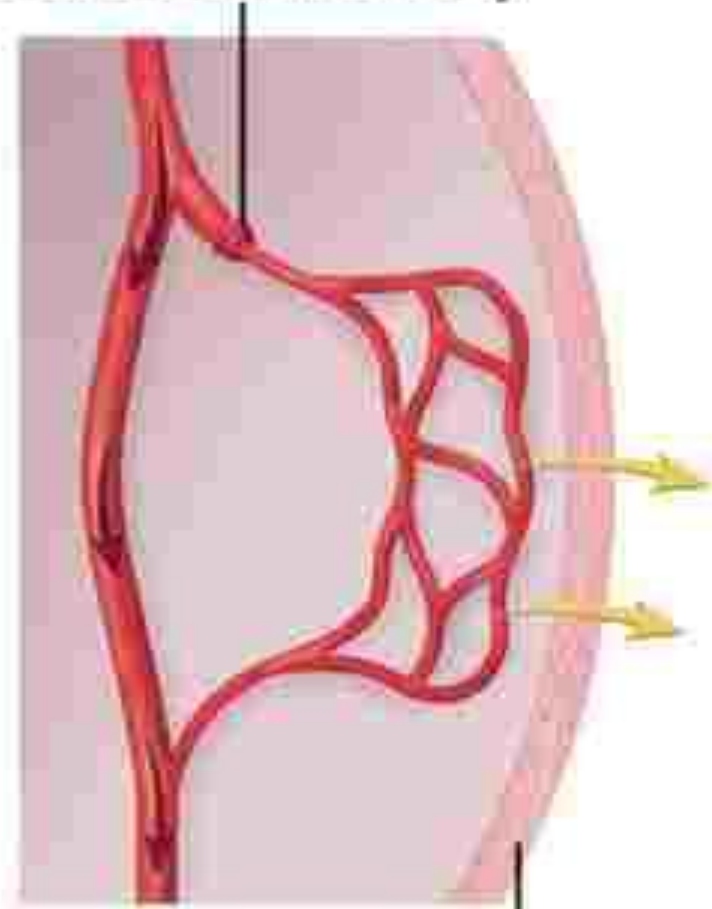
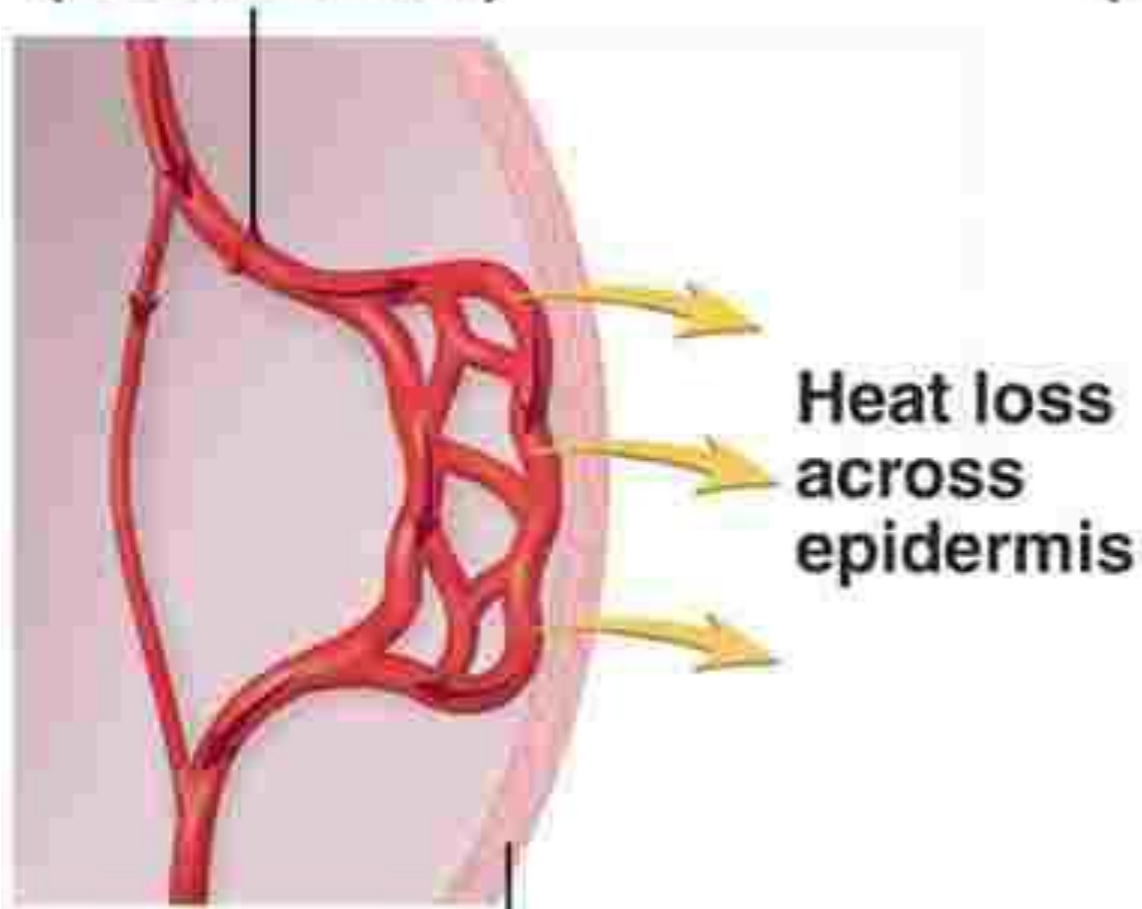
# Functions of the Skin

## **5-Skin helps regulate body temperature**

If the outside temperature is extremely cold and blood flow to the skin is severely restricted for an extended period, a portion of the skin will die, resulting in frostbite.

## Blood vessel dilates (vasodilation)

## Blood vessel constricts (vasoconstriction)



Heat loss  
across  
epidermis

Epidermis

Epidermis

Increased heat loss

Heat conservation

# Functions of the Skin

## 6-Excretion

Limited amount of nitrogenous wastes

Water and salts in sweat

# Hyperthermia and Hypothermia

- **Hyperthermia**, a body temperature above normal, and **hypothermia**, a body temperature below normal, indicate that the body's regulatory mechanisms have been overcome.



# Hypothermia

## **Hypothermia is characterized by:**

- Uncontrollable shivering
- Incoherent speech
- Lack of coordination.
- Slow pulse rate.
- Hallucinations occur as unconsciousness develops.
- Shallow breathing

- In **heat exhaustion**, blood pressure may be low, and salts may have been lost due to profuse sweating. Even so, body temperature remains high.

- **Heat stroke** is characterized by an elevated temperature, up to 43C with no sweating.

- **Fever** is a special case of hyperthermia that can be brought on by a bacterial infection. When the fever “breaks,” sweating occurs as the normal set point for body temperature returns.

# Disorders Of The Skin

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- The skin is subject to many disorders, some of which are more annoying than life-threatening.

# Athlete's foot

- It is caused by a fungal infection that usually involves the skin of the toes and soles





# Impetigo

- It is a highly contagious disease occurring most often in young children. It is caused by a bacterial infection that results in pustules that crust over.





# Psoriasis

- It is a chronic condition, possibly hereditary, in which the skin develops pink or reddish patches covered by silvery scales due to overactive cell division.





# Eczema

- It is an inflammation of the skin, is caused by sensitivity to various chemicals (e.g., soaps or detergents), to certain fabrics, or even to heat or dryness.



# Dandruff

- It is a skin disorder not caused by a dry scalp, as is commonly thought, but by an accelerated rate of keratinization in certain areas of the scalp, producing flaking and itching.





# Urticaria

- It is an allergic reaction characterized by the appearance of reddish, elevated patches and often by itching





# Skin Cancer

```
graph TD; A[Skin Cancer] --> B[Melanoma]; A --> C[Non-Melanoma]; C --> D[basal cell carcinoma]; C --> E[squamous cell carcinoma];
```

**Melanoma**

**Non-  
Melanoma**

basal cell  
carcinoma

squamous  
cell  
carcinoma

- Nonmelanoma cancers, which include basal cell carcinoma and squamous cell carcinoma, are much less likely to metastasize than melanoma cancer.

- **Basal cell carcinoma** the most common type of skin cancer, begins when ultraviolet (UV) radiation causes epidermal basal cells to form a tumor, while at the same time suppressing the immune system's ability to detect the tumor.

# Basal cell carcinoma



- **Squamous cell carcinoma** begins in the epidermis proper. While five times less common than basal cell carcinoma, it is more likely to spread to nearby organs, and death occurs in about 1% of cases.



# Squamous cell carcinoma



- **Melanoma**, the type that is more likely to be malignant, starts in the melanocytes and has the appearance of an unusual mole. Unlike a normal mole, which is dark, circular, and confined, a melanoma mole looks like a spilled ink spot, and a single melanoma mole may display a variety of shades.

# Melanoma



# Burns

- The epidermal injury known as a burn is usually caused by heat but can also be caused by radioactive, chemical, or electrical agents.
- Two factors affect burn severity: the depth of the burn and the extent of the burned area.

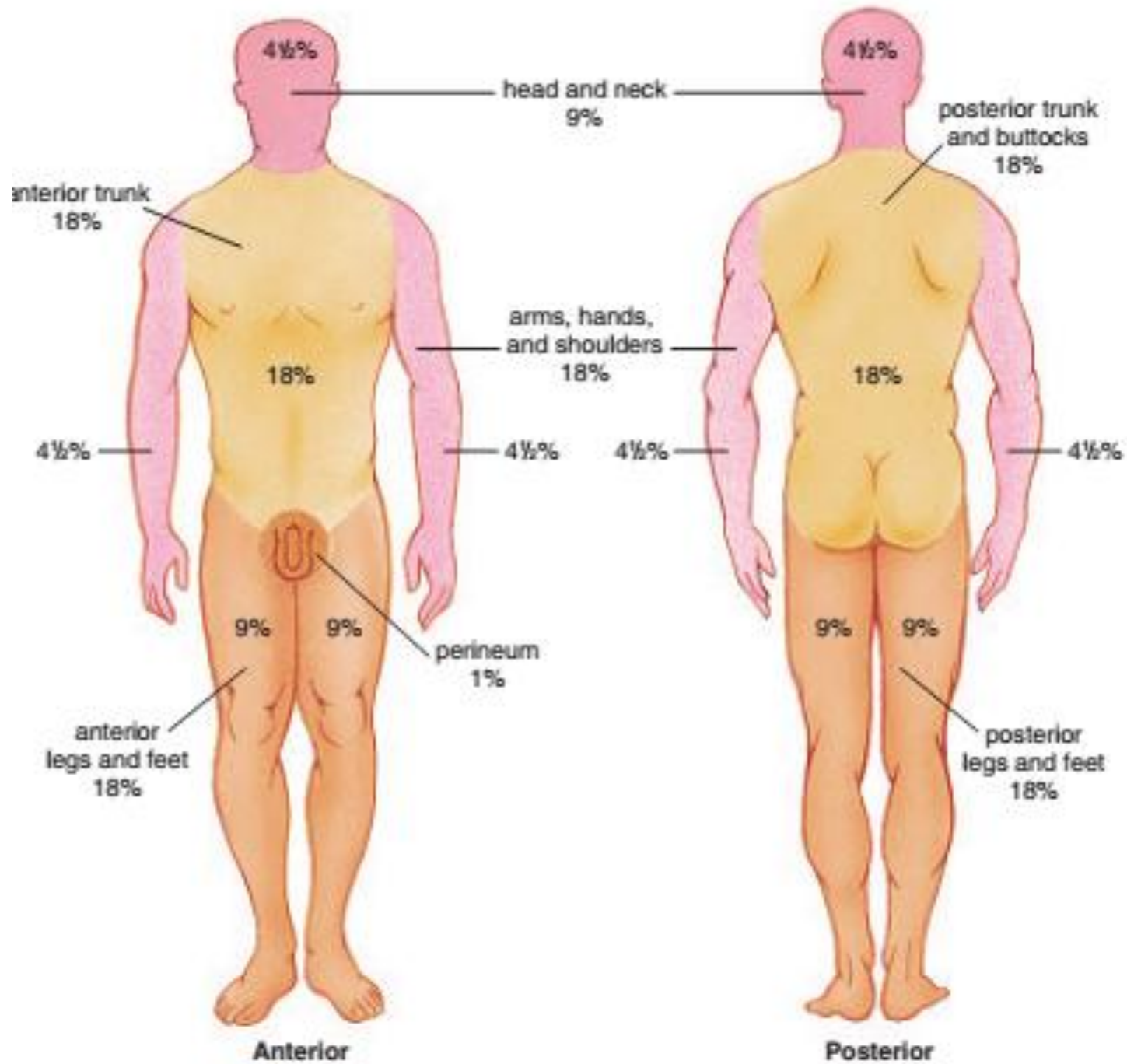
# Rule Of Nines

- A useful technique for estimating the extent of a burn, called the “rule of nines,” is often employed.

# Rule Of Nines

**In this method, the total body surface is divided into regions as follows:**

- The head and neck, 9% of the total body surface.
- Each upper limb, 9%.
- Each lower limb, 18%.
- The front and back portions of the trunk, 18% each.
- The perineum, which includes the anal and urogenital regions, 1%.



Anterior

Posterior



## Classification of burns

### 1- First degree burns:

- It is small limited area ( red in color ) . .
- It involves epidermis & associated with minor pain.





## Classification of burns

### 2- Second degree :

- It involves epidermis & dermis .
- It is manifested by erythema & skin blister.



## Classification of burns

### 3- 3<sup>rd</sup>. Degree :

- It involves epidermis , dermis & subcutaneous tissues .
- The patient will exhibit scarring & may require graft .



Epidermis

Dermis

Subcutaneous

Muscle



Superficial  
(first degree)  
burn



Partial thickness  
(second degree)  
burn



Full thickness  
(third degree)  
burn





## Classification of burns

### 4- 4rth . Degree :

- Damage to muscles , tendons, & ligaments .It needs graft



## Classification of burns

**5- Fifth degree burns** : In which the burned area will be paralyzed .The damage include , muscles , tendon , bones , nerves & blood vessels .

## Classification of burns

### **6- Six degree burn :**

- Blackened bone & damaging marrow tissue .
- It is fatal condition & mortality rate is very high .

# Major concerns with severe burns

- **Fluid loss** is counteracted by intravenous administration of a balanced salt solution.
- **Heat loss** is minimized by placing the burn patient in a warm environment.
- **Bacterial infection** is treated by isolation and the application of an antibacterial dressing.

- As soon as possible, the damaged tissue is removed, and skin grafting is begun.
- The skin needed for grafting is usually taken from other parts of the patient's body.
- This is called autografting, as opposed to heterografting, in which the graft is received from another person.



- Autografting is preferred because rejection rates are very low.
- However, if the burned area is quite extensive, it may be difficult to acquire enough skin for autografting. In that case, skin can be grown in the laboratory from only a few cells taken from the patient.



# **Aging effect on the skin**

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- As aging occurs, the epidermis maintains its thickness, but the turnover of cells decreases.
- The dermis becomes thinner, the dermal papillae flatten, and the epidermis is held less tightly to the dermis so that the skin is looser.

- Adipose tissue in the hypodermis of the face and hands also decreases, which means that older people are more likely to feel cold

- The fibers within the dermis change with age. The collagenous fibers become coarser, thicker, and farther apart; therefore, there is less collagen than before.

- Elastic fibers in the upper layer of the dermis are lost, and those in the lower dermis become thicker, less elastic, and disorganized.

- Many of the changes that occur in the skin as a person ages appear to be due to sun damage. Ultraviolet radiation causes rough skin, mottled pigmentation, fine lines and wrinkles, deep furrows, numerous benign skin growths, and the various types of skin cancer.



## **The skin wrinkles because**

(1) the epidermis is loose

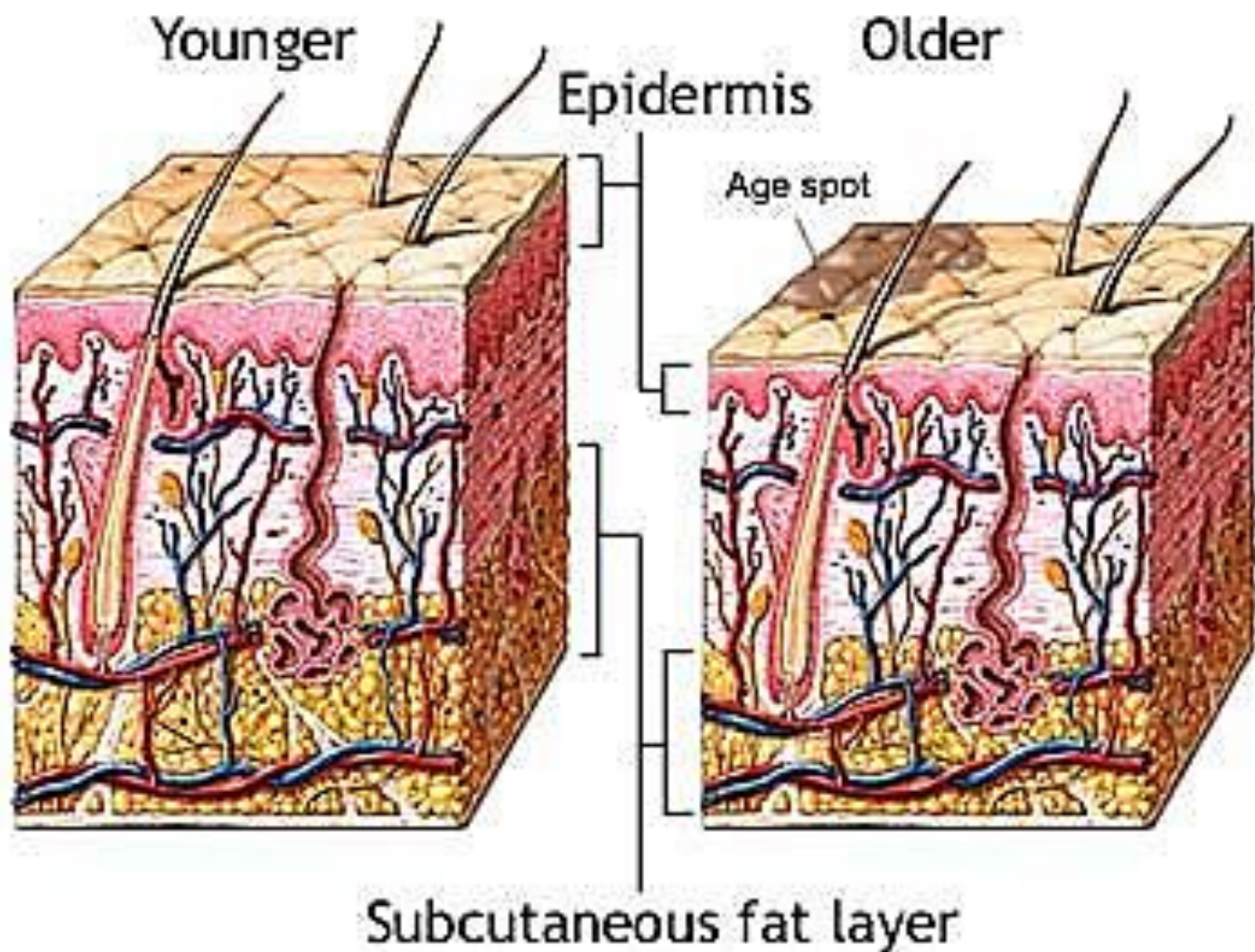
(2) the fibers are fewer and those remaining are disorganized,

(3) the hypodermis has less padding.

- With aging, homeostatic adjustment to heat is limited due to less vasculature (fewer blood vessels) and fewer sweat glands. The number of hair follicles decreases, causing the hair on the scalp and extremities to thin. Because of a reduced number of sebaceous glands, the skin tends to crack

- As a person ages, the number of melanocytes decreases. This causes the hair to turn gray and the skin to become paler.
- In contrast, some of the remaining pigment cells are larger, and pigmented blotches appear on the skin.





# **Integumentary System And Other Body Systems**

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# Skeletal System

Skin protects bones; helps provide vitamin D for  $\text{Ca}^{2+}$  absorption.

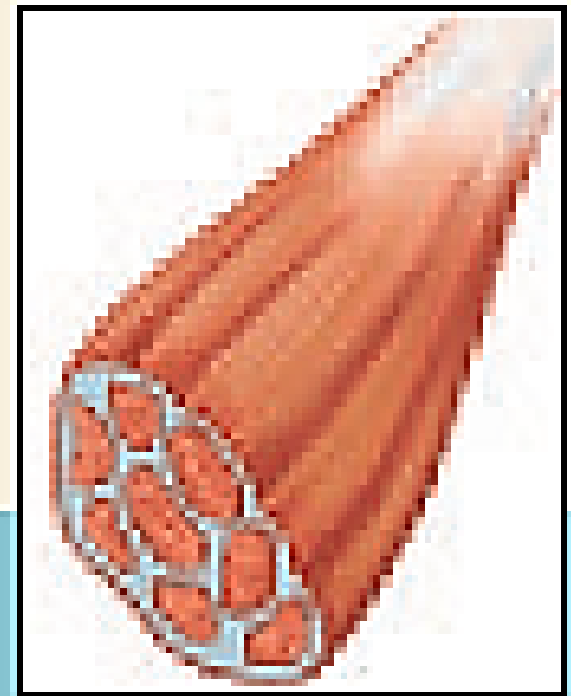
Bones provide support for skin.





# Muscular System

Skin protects muscles;  
rids the body of or conserves  
heat produced by muscle  
contraction.



Muscle contraction provides  
heat to warm skin.

# Nervous System

Skin protects nerves, helps regulate body temperature; skin receptors send sensory input to brain.

Brain controls nerves that regulate size of cutaneous blood vessels, activate sweat glands and arrector pili muscles.



# Endocrine System

Skin helps protect endocrine glands.

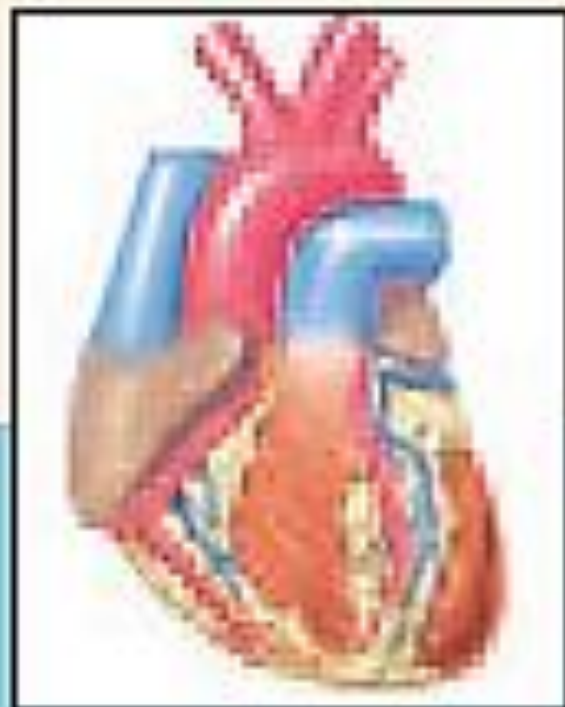
Androgens activate sebaceous glands and help regulate hair growth.



# Cardiovascular System

Skin prevents water loss; helps regulate body temperature; protects blood vessels.

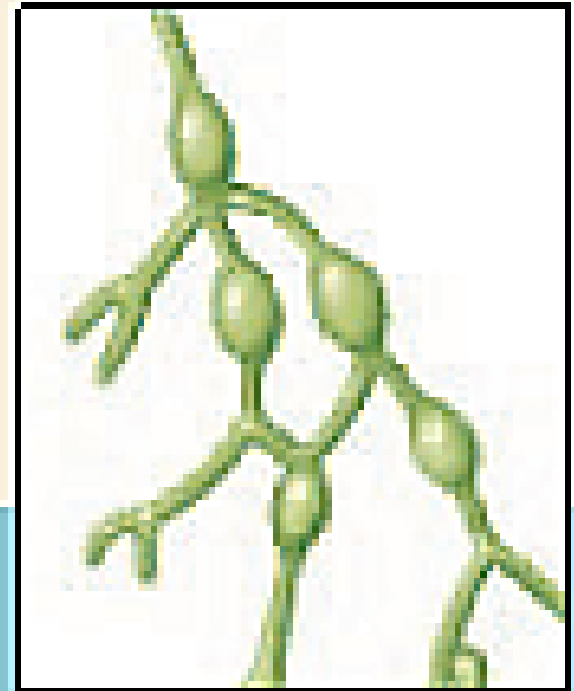
Blood vessels deliver nutrients and oxygen to skin, carry away wastes; blood clots if skin is broken.



# Lymphatic System/Immunity

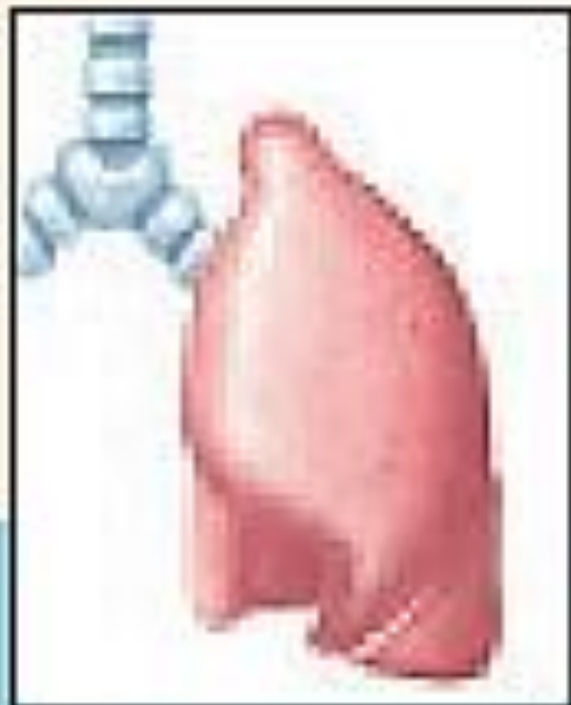
Skin serves as a barrier to pathogen invasion; Langerhans cells phagocytize pathogens; protects lymphatic vessels.

Lymphatic vessels pick up excess tissue fluid; immune system protects against skin infections.



# Respiratory System

Skin helps protect respiratory organs.

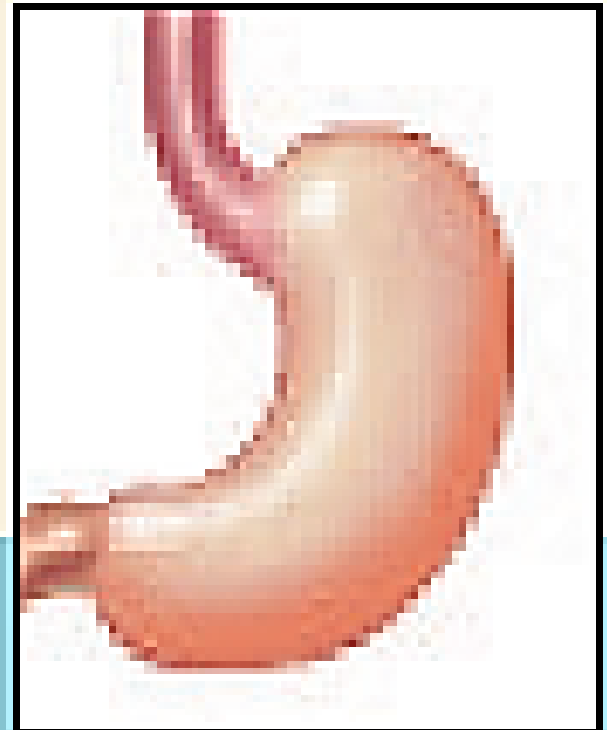


Gas exchange in lungs provides oxygen to skin and rids body of carbon dioxide from skin.

# Digestive System

Skin helps to protect digestive organs; helps provide vitamin D for  $\text{Ca}^{2+}$  absorption.

Digestive tract provides nutrients needed by skin.

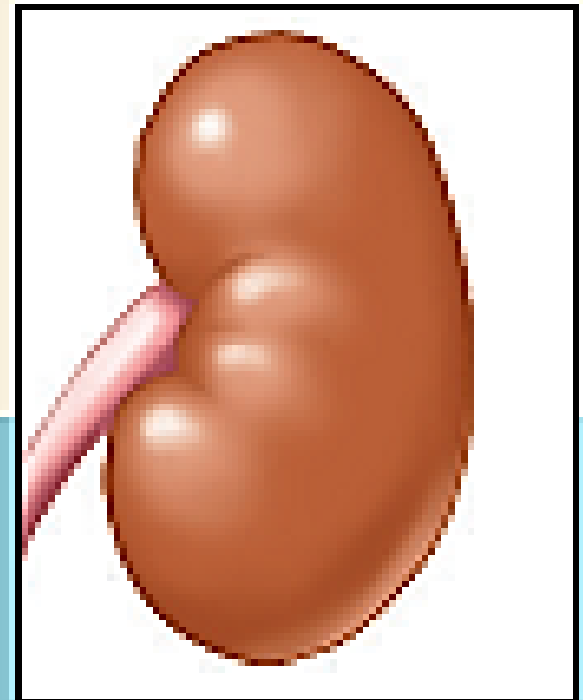




# Urinary System

Skin helps regulate water loss; sweat glands carry on some excretion.

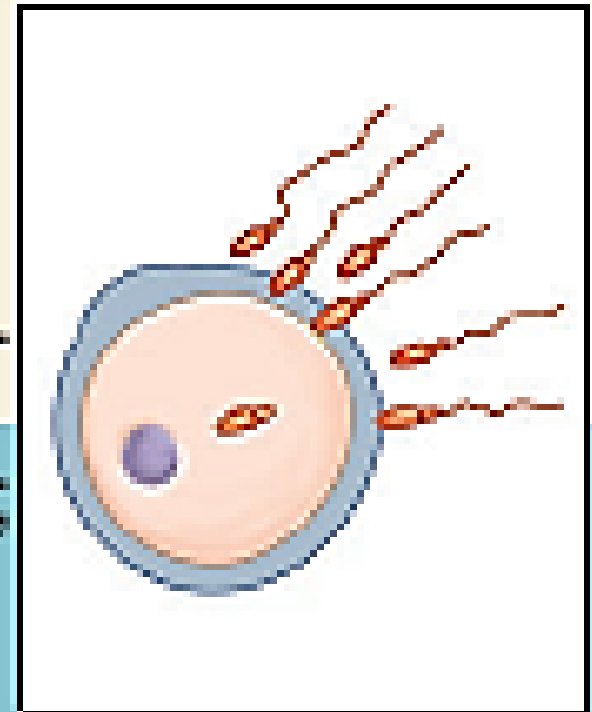
Kidneys compensate for water loss due to sweating; activate vitamin D precursor made by skin.



# Reproductive System

Skin receptors respond to touch; mammary glands produce milk; skin stretches to accommodate growing fetus.

Androgens activate oil glands; sex hormones stimulate fat deposition, affect hair distribution in males and females.





Thank  
you!