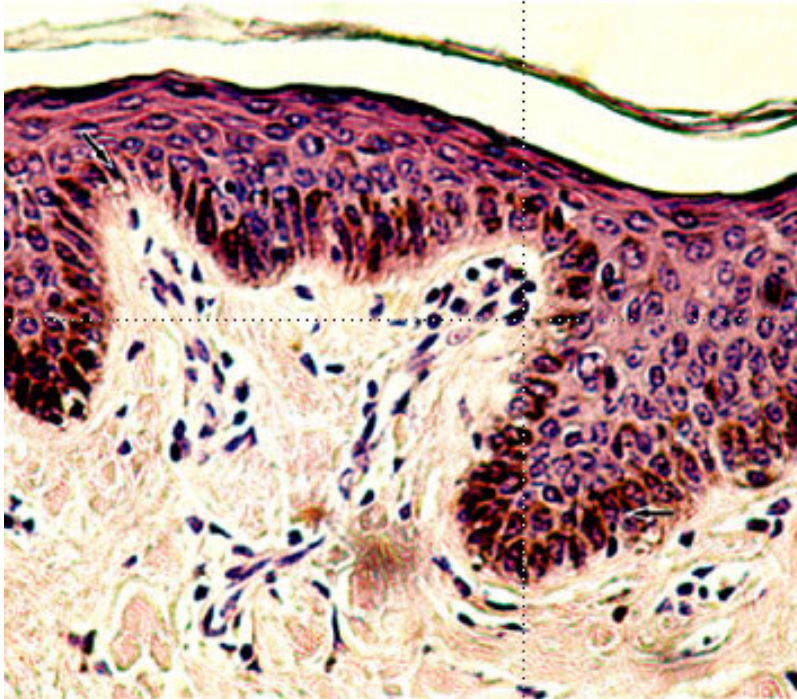


**BIO 225:**

**HUMAN ANATOMY & PHYSIOLOGY I**



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**CHAPTER 06**  
**-Skin-**  
**-Integumentary-**

**Dr. Lawrence G. Altman**  
*Illustrations courtesy of McGraw-Hill.*



# GENERAL FUNCTIONS

- **Composed of several tissues**
- **Maintains homeostasis**
- **Protective covering**
- **Retards water loss**
- **Regulates body temperature**
- **Houses sensory receptors**
- **Contains immune system cells**
- **Synthesizes chemicals**
- **Excretes small amounts of waste**

The skin is the body's largest organ and consists mostly of two layers:

**EPIDERMIS**

**DERMIS.**

Skin *varies* in thickness mostly due to variations in the **stratum corneum** (uppermost layer).

**EPIDERMIS**: stratified squamous epithelium.  
is “cornified” with the protein **keratin**.

Since it is a **type of epithelium**, it is:

**avascular**:

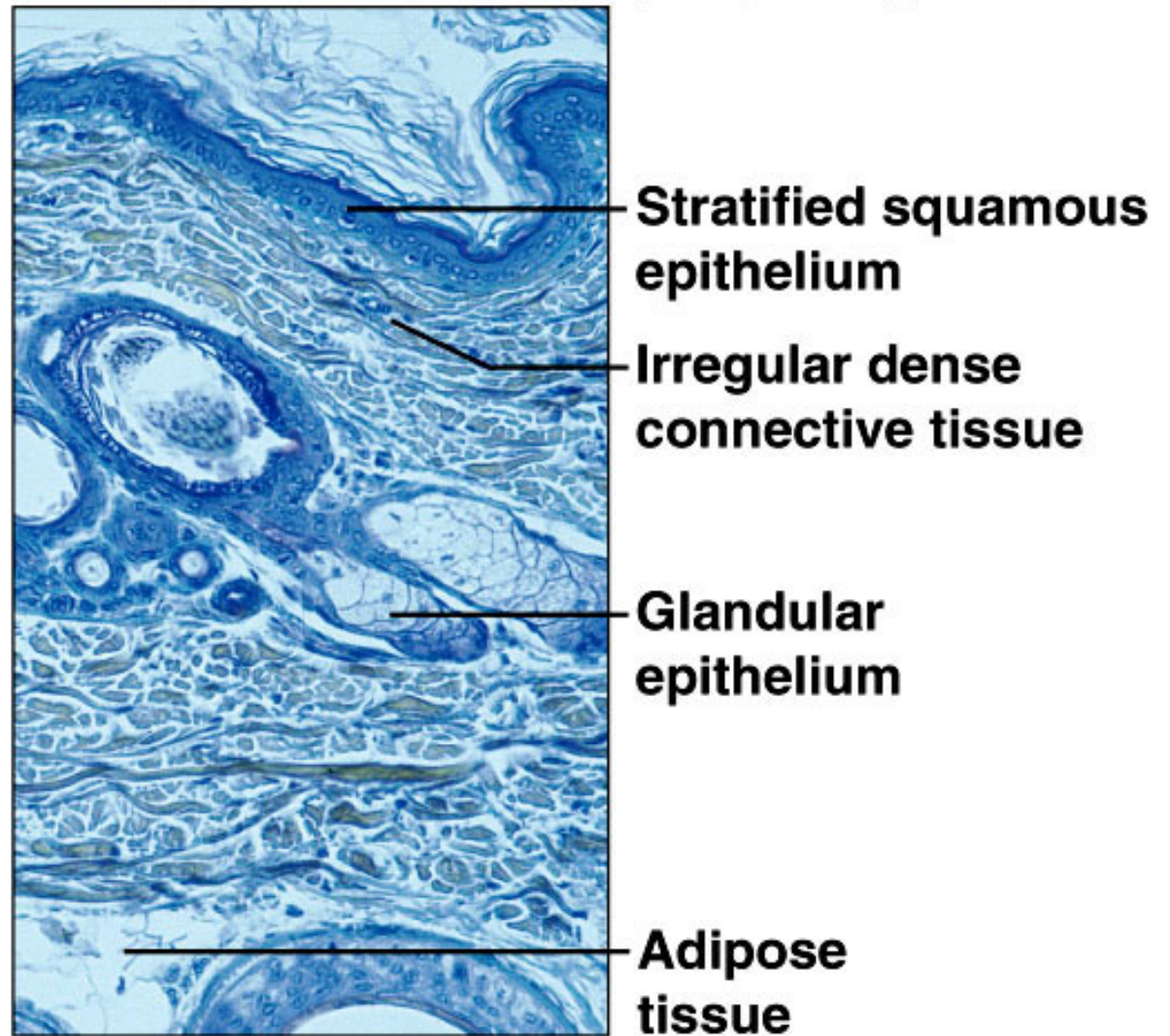
**NO** blood vessels

activities via diffusion

# Layers of Skin

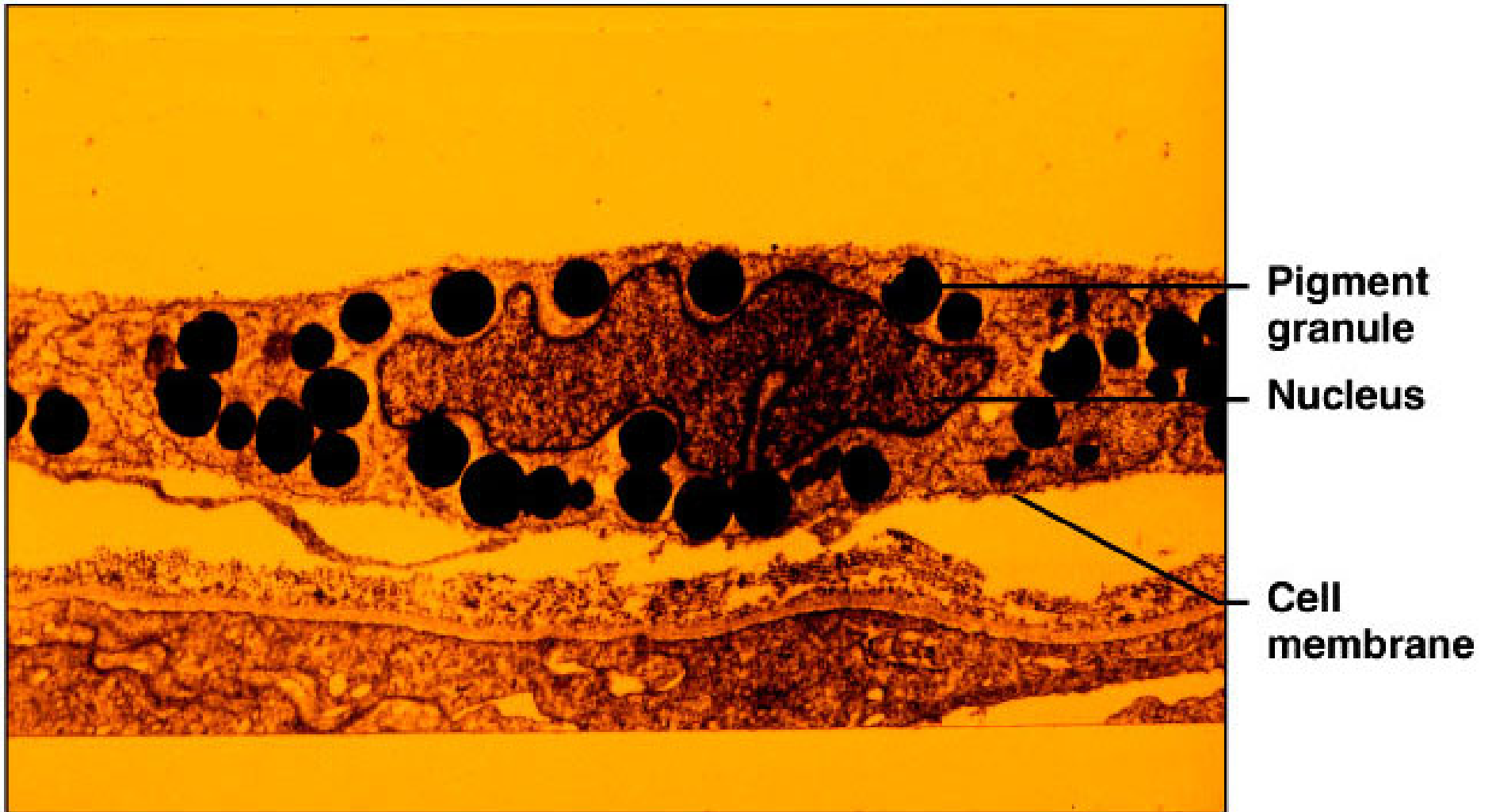
- **Epidermis**
- **Dermis**
- **Subcutaneous layer**

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EPIDERMIS:

1. **Stratum Basale** (sometimes called “germinativum”)
  - a. The stratum basale, a **single layer of low columnar cells**, rests on the basement membrane.
  - b. **Keratinocytes** give rise to most new epidermal cells that are pushed outward *during cell division*.
  - c. **Melanocytes** lie in this layer and produce the *pigment melanin*.  
Melanin is passed **from melanocytes to keratinocytes** through phagocytosis.
  - d. **Merkel cells**: in conjunction with a dermal nerve ending, form a *tactile (touch) receptor* known as a *Merkel disc*.



EPIDERMIS:**2. Stratum Spinosum**

- a. made up of several layers of flattened keratinocytes in which organelles are degenerating. These cells are attached to each other by desmosomes, giving them a spiny appearance as they shrink.
- b. **Macrophages** (called **Langerhans cells**) are present in this layer and the stratum granulosum.

**3. Stratum Granulosum**

- a. This layer consists of two to five layers of cells with granules of **keratohyalin**.

EPIDERMIS:4. **Stratum Lucidum**

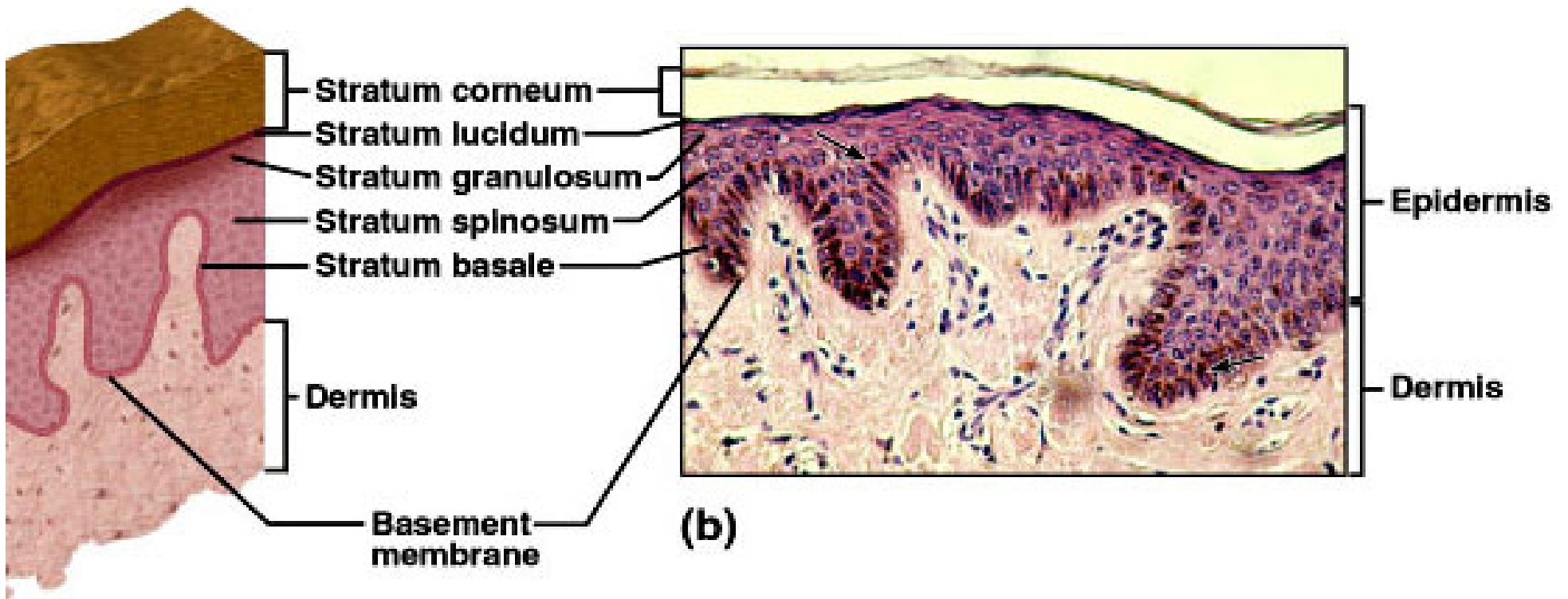
This thin, translucent zone (much matrix) is seen only in thick skin, such as the **soles of the feet**.

5. **Stratum Corneum**

The stratum corneum is made up of **25-30 layers of dead, keratinized cells**.  
-a waterproof, protective outer layer.

DERMIS:

Since connective tissue (CT) will be covered in a separate, dedicated Lab, some areas are of the DERMIS plates are greyed out J. But first, some epidermal images.....



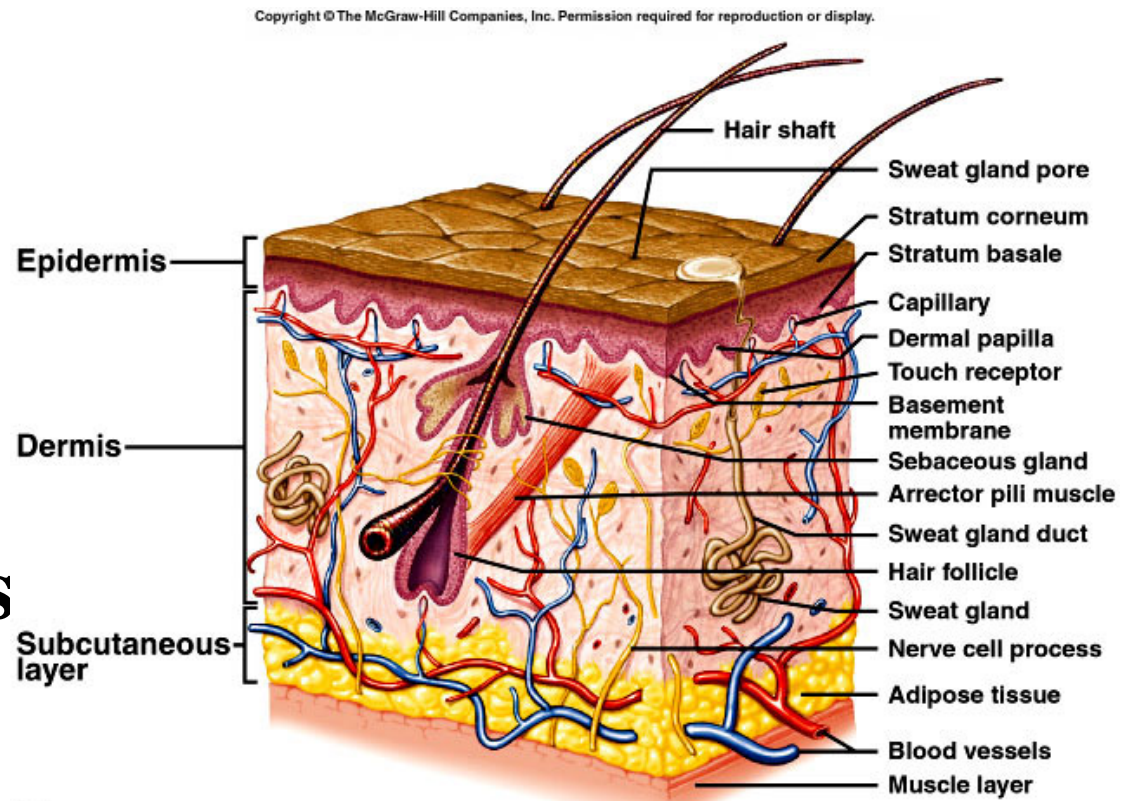
DERMIS:

1. The dermis is primarily composed of fibroconnective tissue, with **blood vessels, nerve endings, sweat glands, hair follicles, and nail roots.**
2. The **papillary layer** of the dermis is a zone of areolar tissue (loose CT) closest to the epidermis, projecting upward as **dermal papillae.**  
*Blood vessels* extend close to the epidermis **within the papillae.**  
The large number of **white blood cells** within this layer helps prevent infection.
3. Reticular layer contains dense irregular connective tissue. Stretching of the skin causes tears in this area, called **linea albicantes**, or stretch marks.

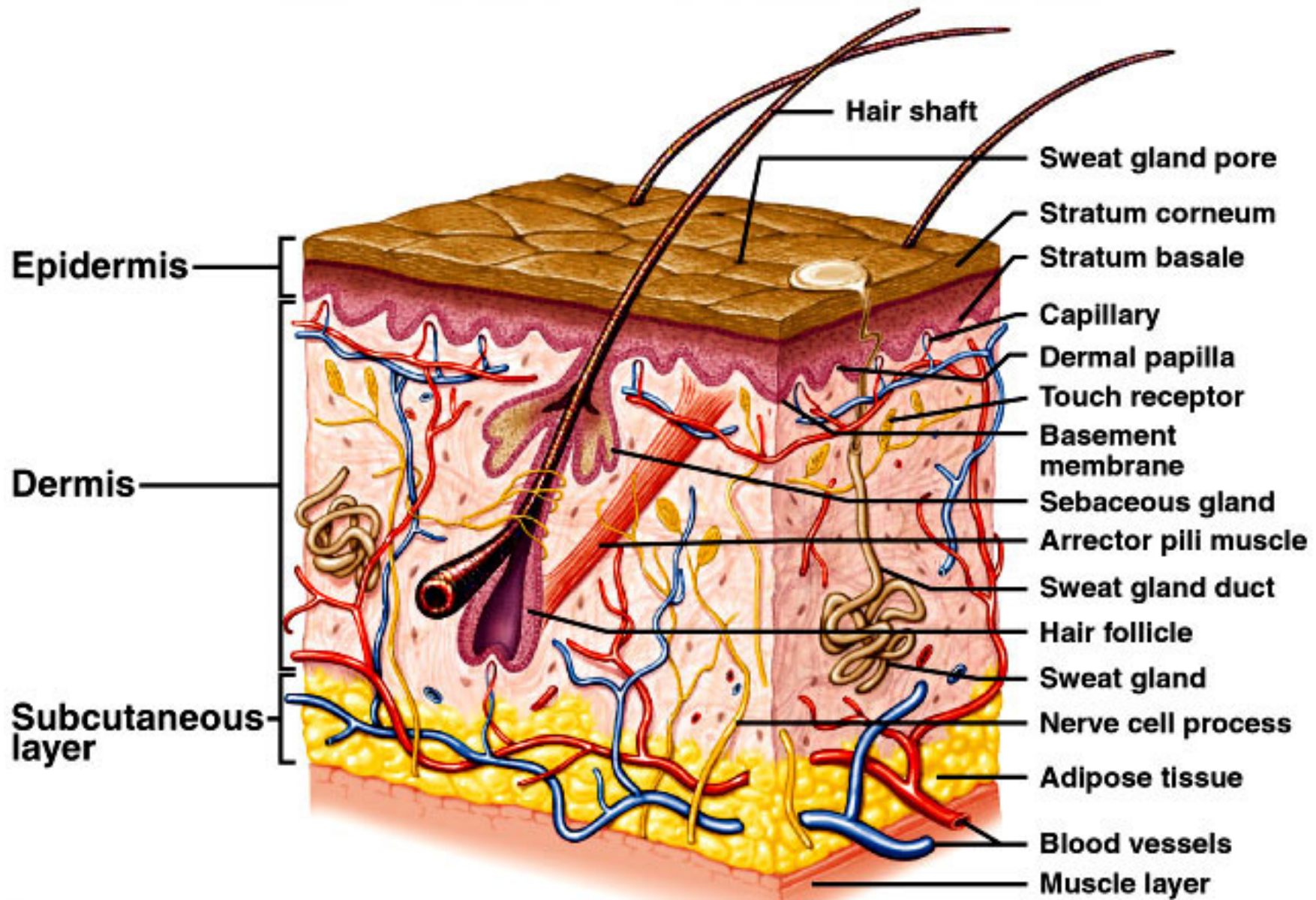
- on average 1.0-2.0 mm thick
- **dermal papillae**
- binds epidermis to underlying tissues
- muscle cells
- irregular dense connective tissue
- nerve cell processes
- blood vessels
- hair follicles
- glands

# Subcutaneous Layer

- hypodermis
- loose connective
- adipose tissue
- insulates
- major blood vessels



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(a)

# Skin Color

## Genetic Factors

- varying melanin amounts
- size of melanin granules
- albinos lack melanin

## Environmental Factors

- sunlight
- UV light from sunlamps
- X rays

## Physiological Factors

- dermal BV dilation
- dermal BV constriction
- carotene (orange)
- jaundice (hepatitis)

Hematoma (bruise) gives a purplish cast.

Erythema: abnormal skin redness.

Shock may cause **pallor**.

Cyanosis: blue (low Oxygen)

## Skin Markings

- hemangiomas (birthmarks),
- moles (nevus), freckles

# SUMMARY of SKIN FUNCTIONS

## A. The Skin as a Barrier

1. **Keratin** and epidermal **desmosomes** make skin a tough barrier to penetration and injury.  
The **dry habitat** of the skin, and the **acid mantle** of sweat are *unfavorable to microbial growth*.
2. The skin is impervious to water (keratin) and a barrier to some ultraviolet radiation.

## B. Vitamin D Synthesis

**UV radiation can penetrate into the dermis** where it reaches the steroid **dehydrocholesterol** found in blood.

The steroid is converted to **cholecalciferol** that the liver and kidneys turn into an **active** form of **vitamin D**.

Vitamin D activity is related to the control of calcium and phosphorous levels in the body.

# **SUMMARY of SKIN FUNCTIONS**

## **C. Cutaneous Absorption**

- 1. The blood receives 1-2% of its oxygen through the skin.**
- 2. Many toxic compounds, as well as fat-soluble vitamins, can be absorbed through the skin.**

## **D. Sensory Roles**

**A variety of types of sensory nerve endings are present in skin.  
(to be discussed at a later date)**

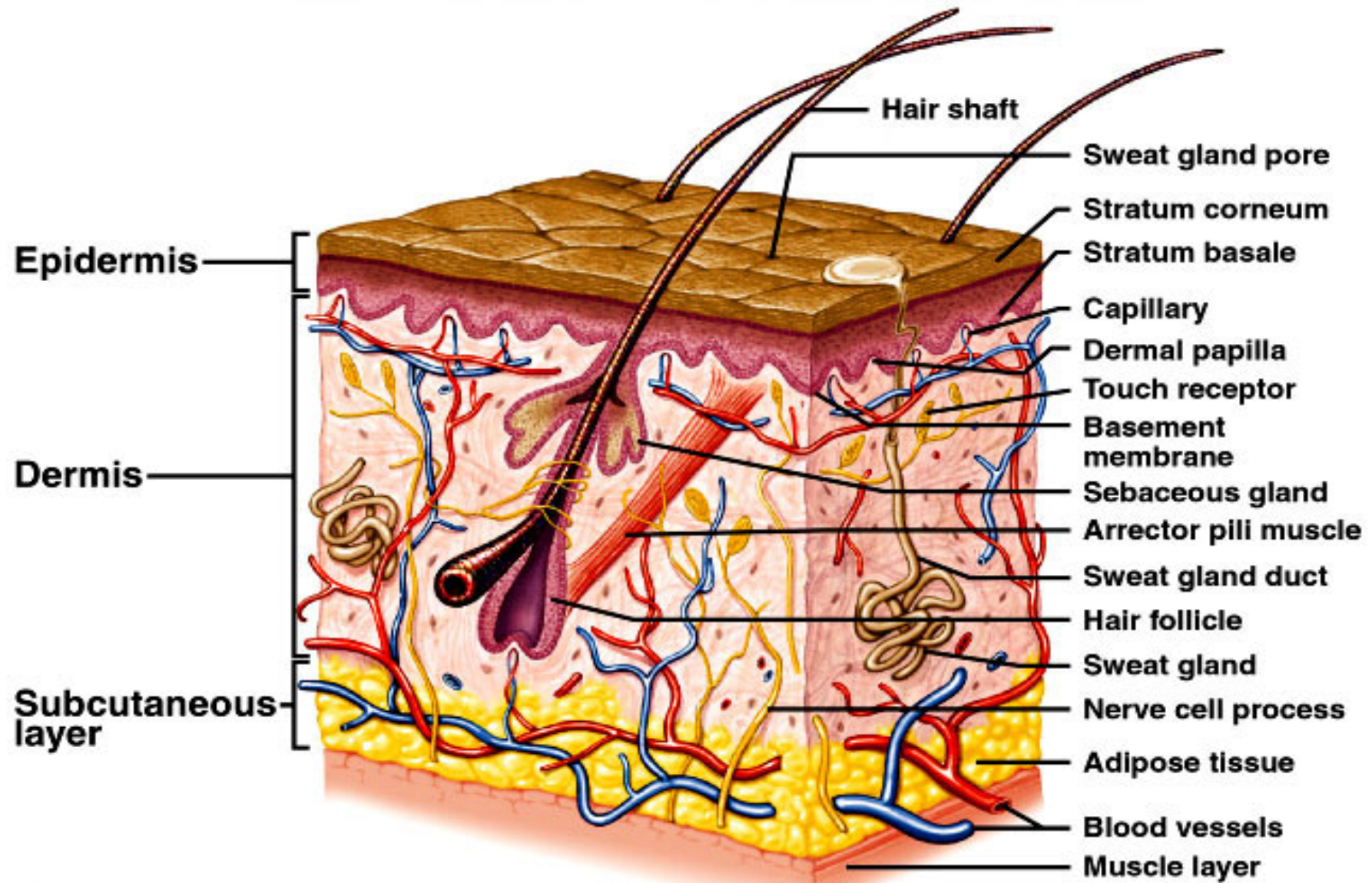
## **E. Thermoregulation**

- 1. The skin functions as an adjustable radiator to regulate body temperature.**
- 2. When cold, dermal blood vessels constrict, thus retaining heat in the body core.**
- 3. When hot, dermal blood vessels dilate, radiating heat to the surroundings.**

**Also, perspiration allows evaporative cooling.**

**Insensible perspiration:** not very noticeable (approx. 500 mls/day)

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# HAIR (*aka Pili*) and NAILS

Both are *accessory organs* to the Skin

Both are made of **hard keratin** (compared to the soft keratin of skin).

## Types and Distribution of Hair:

1. Almost all areas of the skin have hair, **except** lips, nipples palms and soles, and portions of the fingers and genitals.
2. **Lanugo**, a fine, downy, unpigmented hair covers the fetus before birth.
3. Fine, unpigmented hair is otherwise called **vellus**, and covers most of the body.
4. **Terminal hair** is coarser, longer, and pigmented. It can be found on the head and face (men), and in axillary and pelvic regions after puberty.  
Short guard hairs in nose, ear canal = "**vibrissae**"

# HAIR (*aka Pili*) and NAILS

Both are *accessory organs* to the Skin

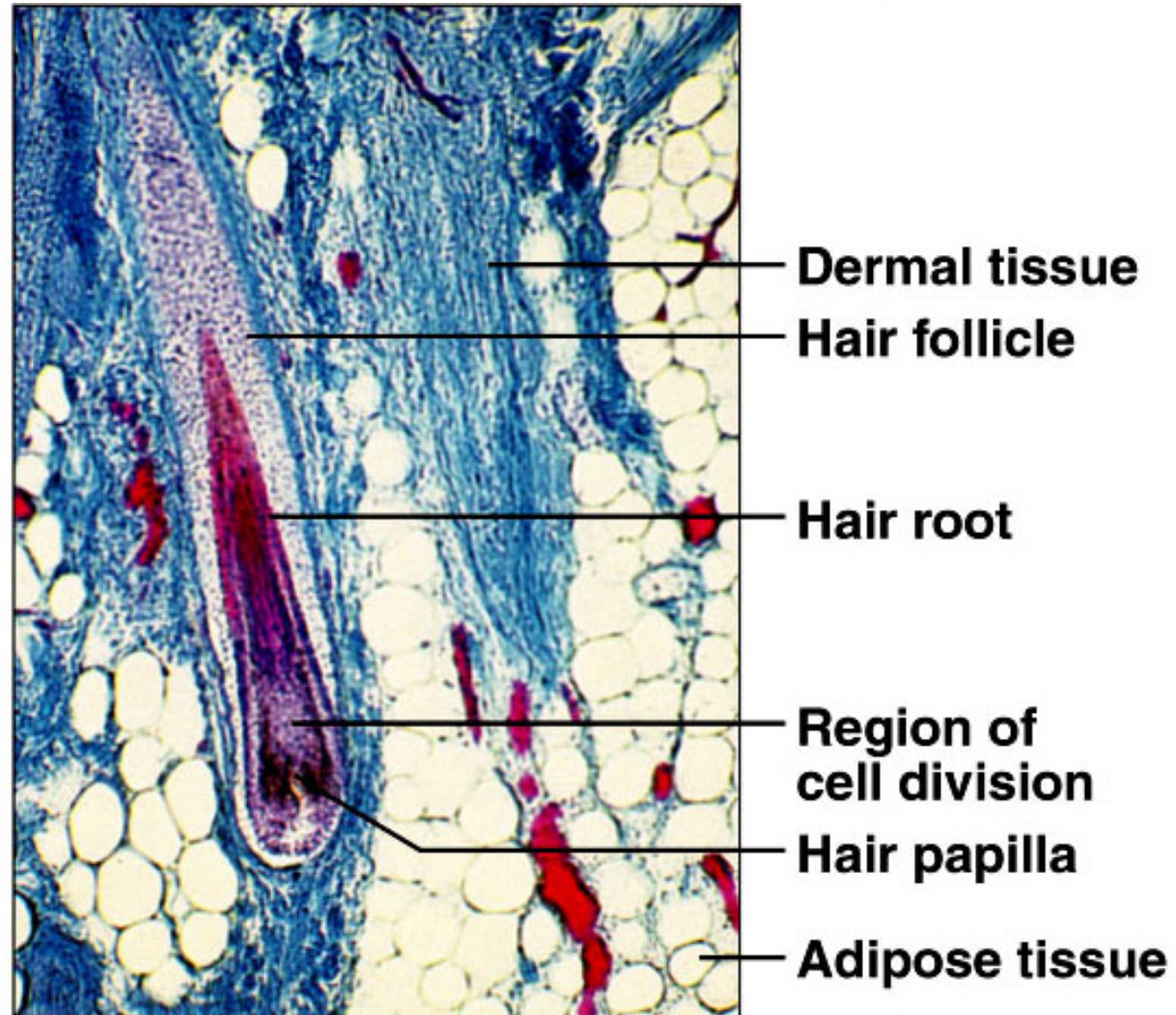
## Structure of the Hair and Follicle

1. The hair itself is divided into the swollen base, where the hair originates, the **root** (the remainder of the hair within its **follicle**), and the **shaft**, the portion above the skin.
2. The color of hair is due to the **relative abundance of keratin**. Red hair also contains **trichosiderin**.
3. The hair **follicle** dips into the **dermis** and has **two layers**.
4. The **epithelial root sheath** is an extension of the **epidermis**.
5. The connective tissue root sheath, derived from the dermis, surrounds the epidermal sheath.
6. Also associated with the follicle are **hair receptors**, and an **arrector pili** muscle: smooth muscle (involuntary), hair erect.

# HAIR (*aka* Pili) and NAILS

Both are *accessory organs* to the Skin

Structure  
of the  
Hair and Follicle

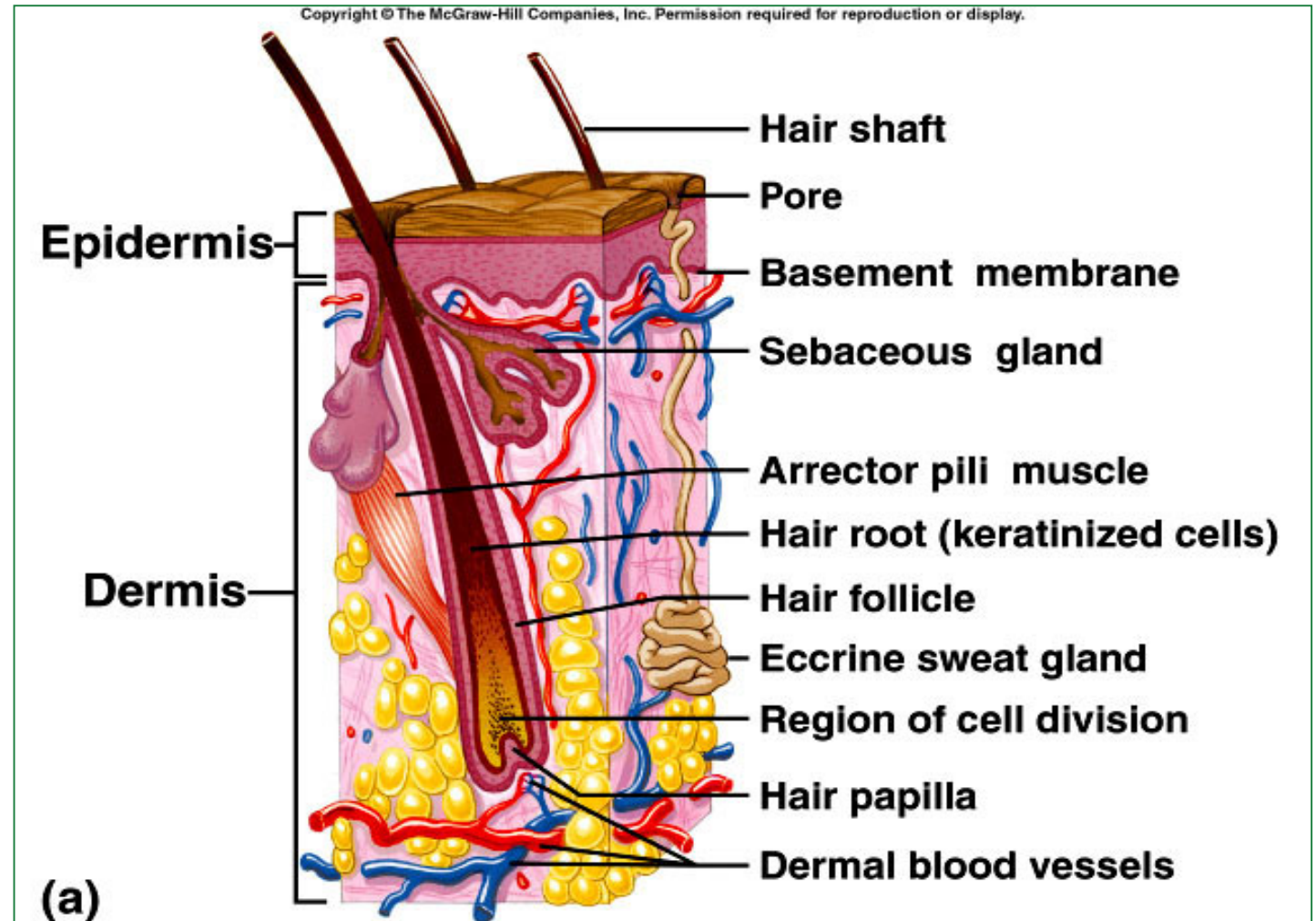


# HAIR (*aka Pili*) and NAILS

Both are *accessory organs* to the Skin

## Structure of the Hair and Follicle

- epidermal cells
- tube-like depression
- extends into dermis
- hair root
- hair shaft
- hair papilla
- dead epidermal cells
- melanin
- arrector pili muscle



# HAIR (*aka Pili*) and NAILS

Both are *accessory organs* to the Skin

## The Growth of Hair

Growth of hair is due to **mitosis** in cells in the **stratum basale** of the epidermal root sheath.

Thinning of the hair (**alopecia**) is usually age-related, but may be influenced by disease, nutrition, emotional trauma, radiation, or chemotherapy.

**Pattern baldness** is more common in males.  
Excessive, unwanted hair: *hypertrichosis*.

# HAIR (*aka Pili*) and NAILS

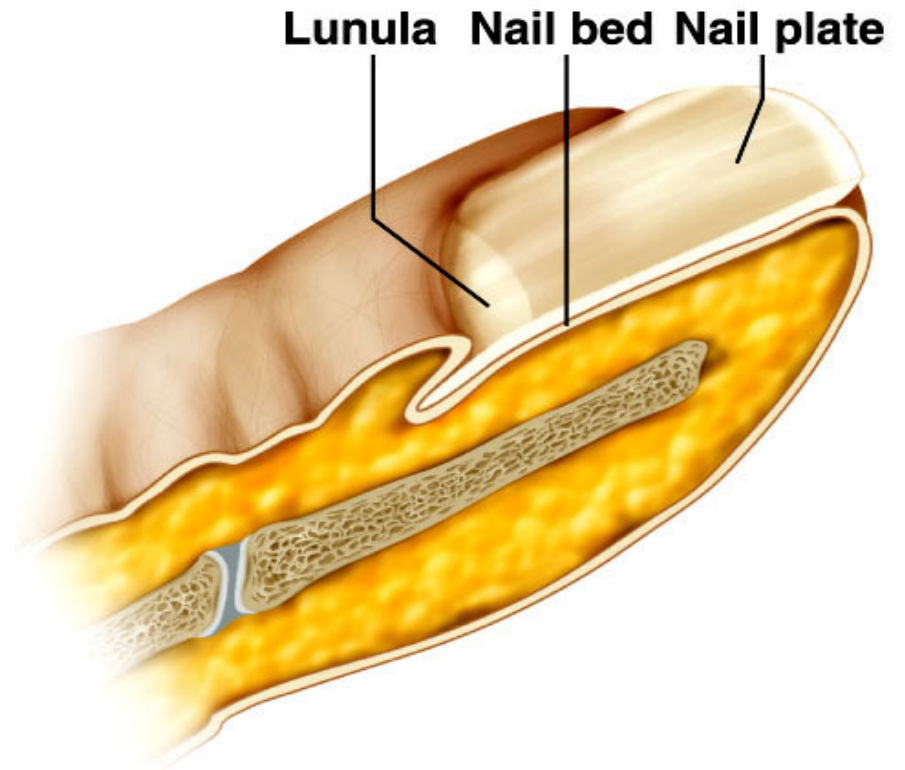
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Both are *accessory organs* to the Skin

## NAILS

- protective coverings
- nail plate (the nail itself)
- nail bed
- lunula

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Nails are clear derivatives of the stratum corneum.

# CUTANEOUS GLANDS

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## SWEAT GLANDS

**Sudoriferous (sweat) glands:** the most numerous cutaneous (skin) glands. Sweat: mostly water; also, salts, ammonia, urea, sugar, uric acid, lactic acid, ascorbic and amino acids.

*Two basic types:*

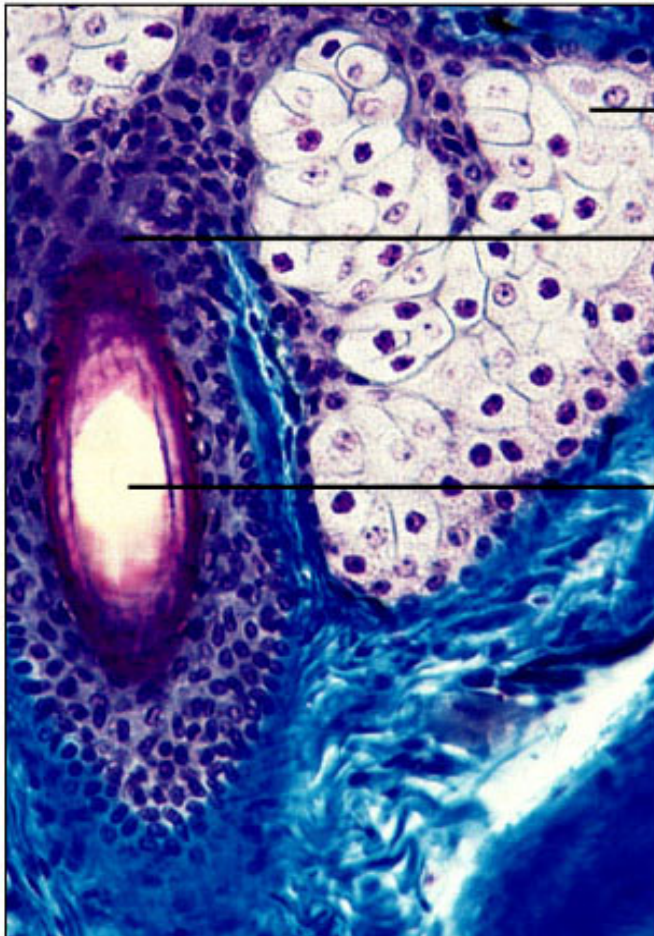
- a. **Merocrine sweat glands:** produce watery perspiration to cool the body; ducts to skin surface. Functional before and after puberty. Sweat not very viscous.
- b. **Apocrine sweat glands** occur in the groin, axilla, and breast areola; also, faces of males; ducts lead into hair follicles. Usually, not functional until puberty. Sweat most viscous. **Develop odors.** Respond to stress and sexual stimulation.

# CUTANEOUS GLANDS

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## SEBACEOUS GLANDS

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Sebaceous gland

Hair follicle

Hair

absent on palms and soles

*Holocrine Gland:*  
Secretes entire contents

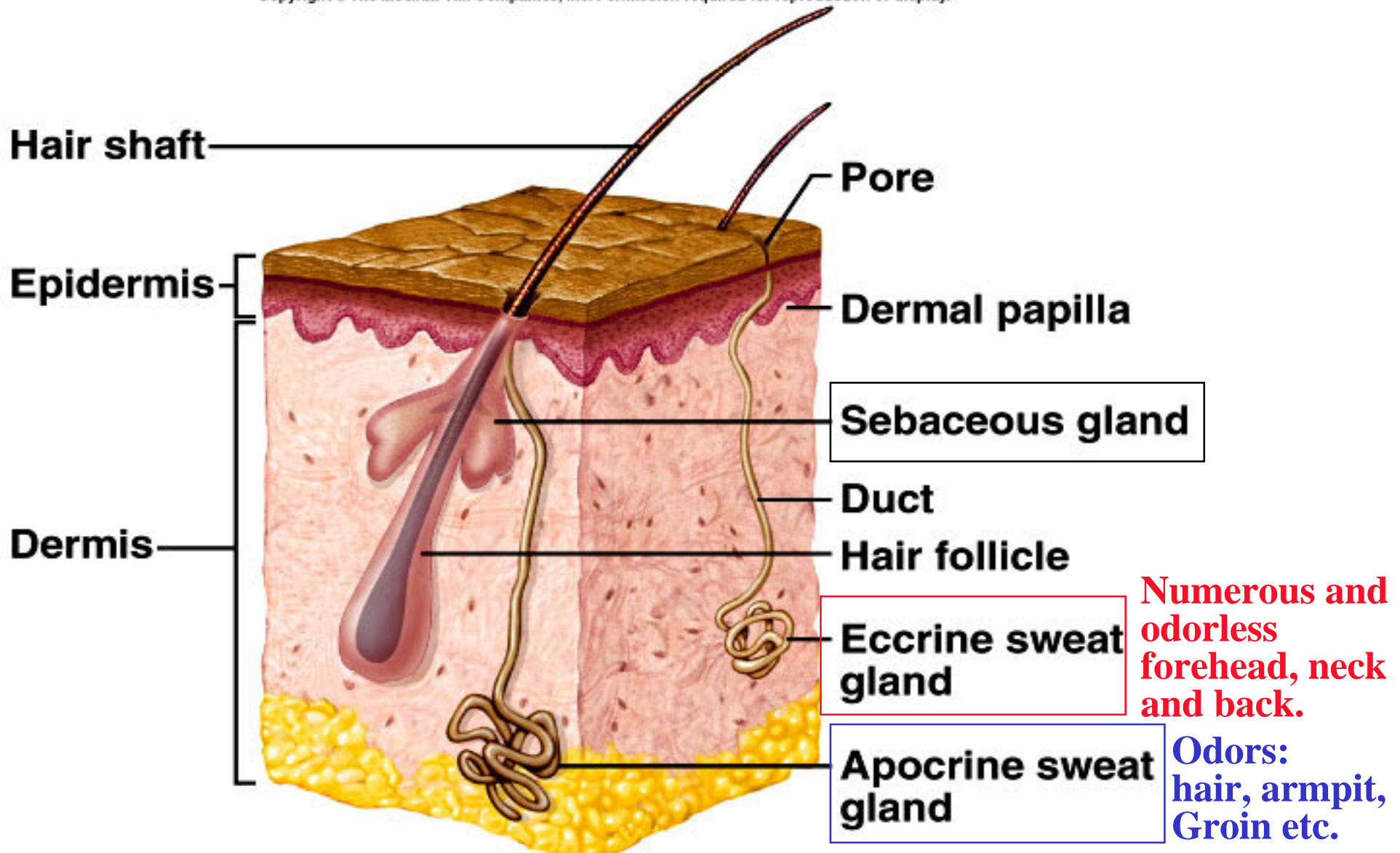
Sebaceous glands produce an oily sebum (cholesterol, fats, proteins and salts) to moisturize the skin and hair.

*If associated with hair*, then contents released via **ducts into the hair follicle**.

*If not associated with hair*, ducts open onto the surface of the skin. Examples- **lips, eyelids, glans penis, labia minora**.

# CUTANEOUS GLANDS

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# CUTANEOUS GLANDS

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## CERUMINOUS GLANDS

### Ceruminous glands:

found only in the external ear canal where they produce **cerumen** (earwax). They are a type of modified sweat gland.

## BREAST and MAMMARY GLANDS

### Breasts and Mammary glands:

Mammary glands are modified **apocrine** sweat glands.

Both men and women have breasts; it is only during pregnancy and lactation that women develop mammary gland tissue within the breasts capable of producing and secreting milk.

## AGING

1. At puberty, the skin of women thickens somewhat. Otherwise, it contains more blood vessels than that of men, thus women blush and bleed more easily.
2. After age 40, skin degenerative changes (senescence) become more noteworthy.

## SKIN CANCER

1. With increasing age and UV exposure, the development of skin cancer becomes more likely.
2. Skin cancer is the **most common of all cancers, with basal cell carcinoma** (arising from the stratum basale) the **most frequent skin cancer**. It appears as a raised bump with a central depression, and seldom metastasizes.

## SKIN CANCER

3. **Squamous cell carcinoma** arises from the stratum spinosum usually on the scalp, ears, lips, or hands.

This cancer is readily curable, but can metastasize and turn deadly if left untreated.

4. The deadliest, but least common, form of skin cancer is malignant **melanoma**.

It usually arises from **melanocytes** in a preexisting mole.

It is most likely in those who suffered severe sunburns as children, especially redheads.

# Integumentary Aging and Disease

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## SKIN CANCER



**Squamous Cell  
Carcinoma**



**Basal Cell  
Carcinoma**



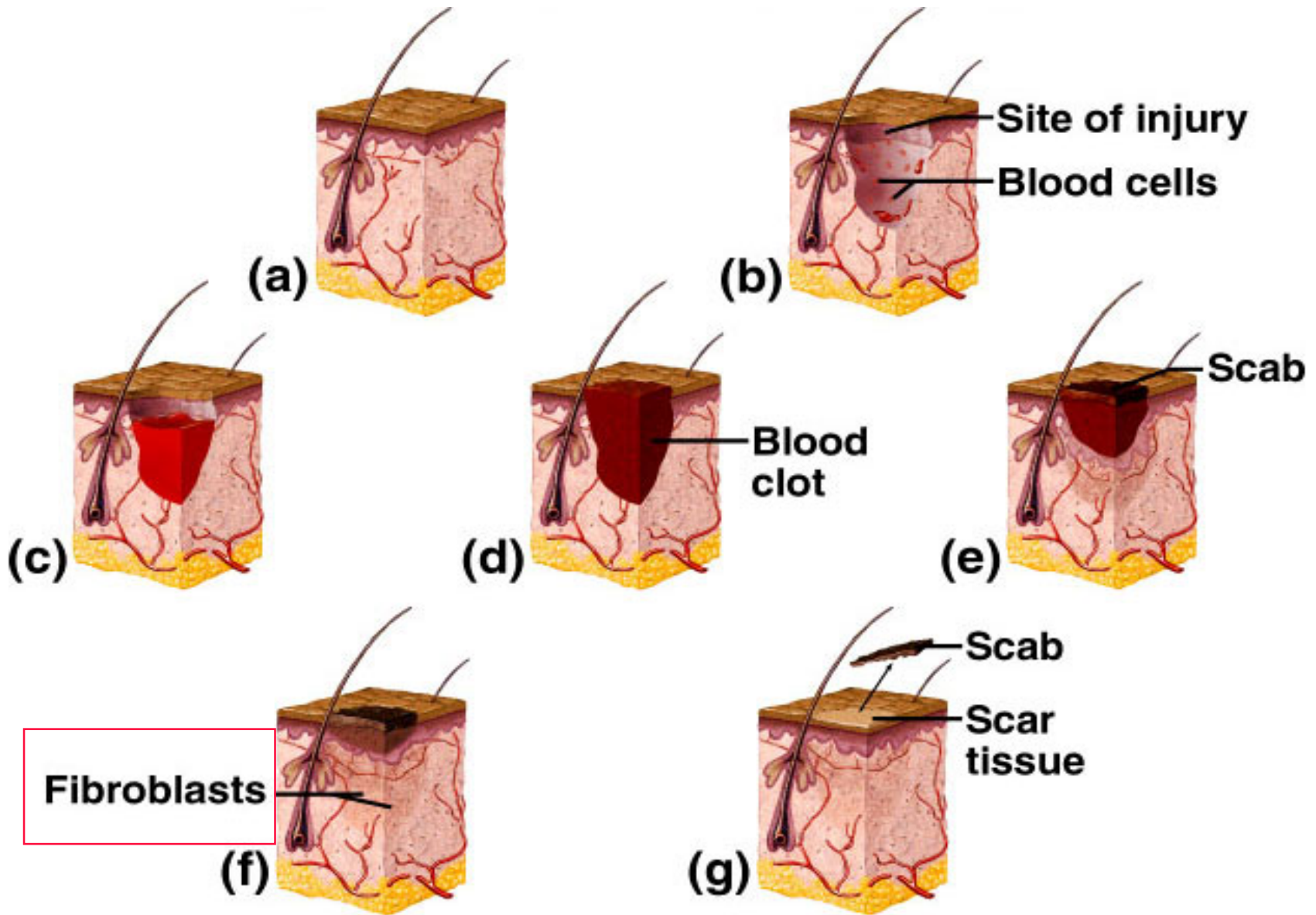
**Malignant  
Melanoma**

# Life Span Changes

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- Scaly skin
- Age spots
- Dermis becomes reduced
  - Loss of fat
  - Wrinkles
  - Sagging
- Sebaceous glands secrete less oil.
  - Melanin production slows
  - Hair thins
- Number of hair follicles decrease
  - Impaired nail growth
  - Sensory receptors decline
- Inability to control body temperature
  - Less vitamin D production

# Healing of Cuts



1. Burns are the leading cause of accidental death.
2. Burns are classified according to the depth of tissue involvement.

**First-degree burns**  
involve **only the epidermis.**

**Hyperthermia** –  
abnormally high  
body temperature

**Second-degree burns**  
involve the **upper dermis.**

**Hypothermia** –  
abnormally low  
body temperature

**Third-degree burns**  
destroy the **skin and sometimes deeper tissue;**  
"full -thickness burns"

3. With severe burns, fluid and electrolyte replacement, and infection control (and use of **debridement; "cutting away"**) are essential.

# Skin Grafts and Artificial Skin

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**Third degree burns** destroy the dermis, requiring skin grafts.

An **autograft** is taken from the **same person**.

*Grafts from other individuals include:*

**isograft**:

from an identical twin.

**homograft** (allograft):

from an **unrelated person**.

**heterograft** or **xenograft**:

from a *different animal*.

**LAST  
SLIDE**