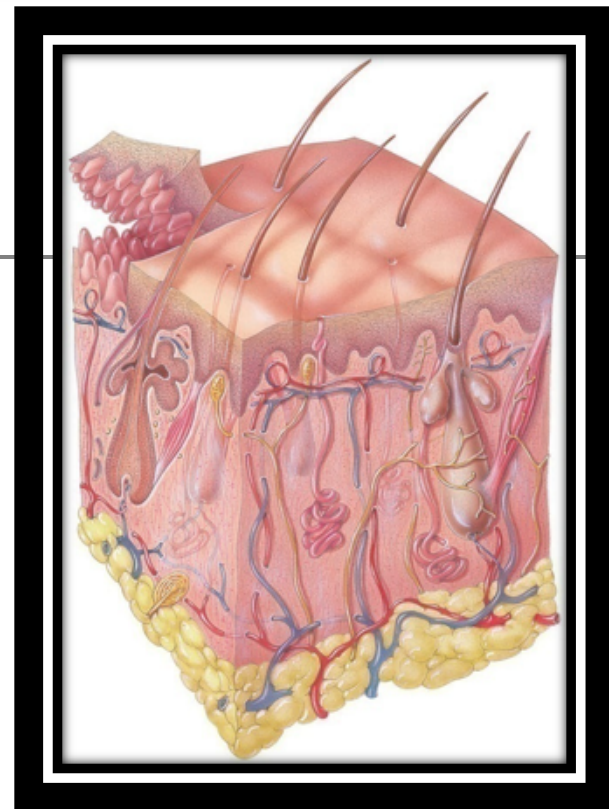


The Integumentary System

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- The **integumentary system** is formed of the skin and its accessory structures. These include:
 - a. Hair
 - b. Arrector pili muscle
 - c. Sebaceous and sweat glands
 - d. Nails
- Functions of the skin:
 - 1. Regulation of body temperature
 - 2. Blood reservoir
 - 3. Protection
 - 4. Cutaneous sensations
 - 5. Excretion and absorption
 - 6. Synthesis of vitamin D

Structure of the Skin

- The skin (**cutaneous membrane**) covers the body and is the largest organ of the body by surface area and weight. Weight is about 16% of body weight. It's thinnest on the eyelids, thickest on the heels.

- The skin is formed of two major layers:
 1. Outer layer called the **epidermis**.
 2. Inner layer called the **dermis**.

- Beneath the dermis is a **subcutaneous layer** (also called the **hypodermis**) which attaches the skin to the underlying tissues and organs.

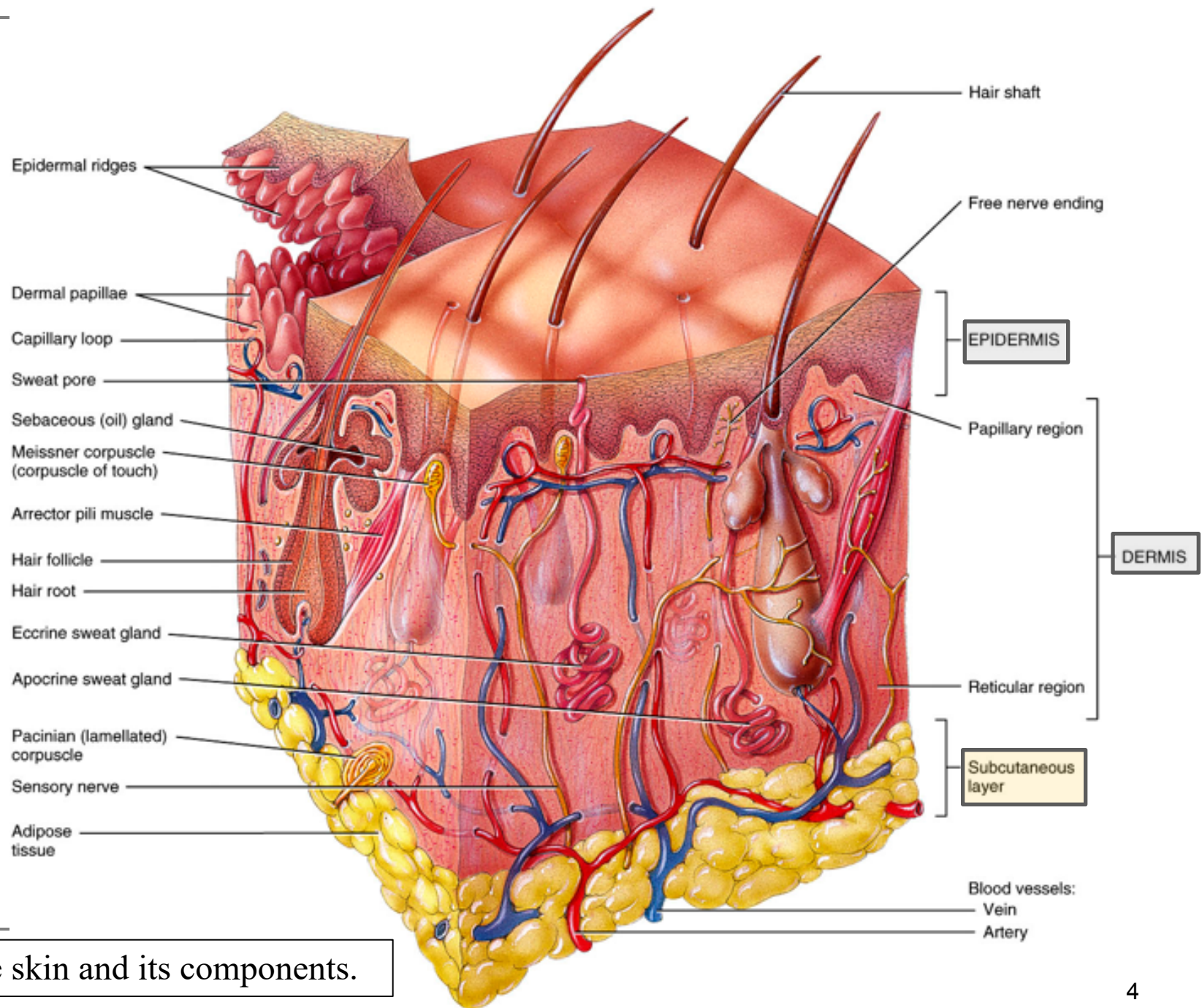


Fig.1: The skin and its components.

The Epidermis

- The epidermis is composed of stratified squamous keratinized epithelium.
- It contains four major types of cells:
 - 1) Keratinocytes (90% of the cells) they form the layers of the epidermis and produce keratin which is a tough fibrous protein that provides protection.
 - 2) Melanocytes: which produce the pigment **melanin** that protects from damage by ultraviolet radiation.

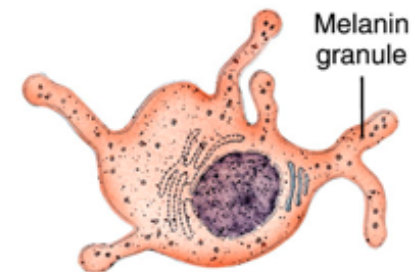
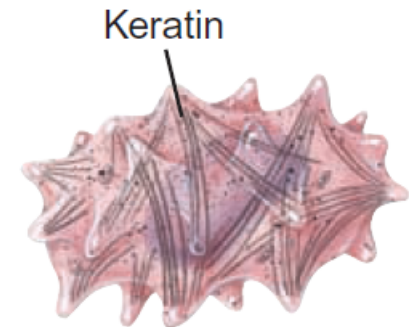
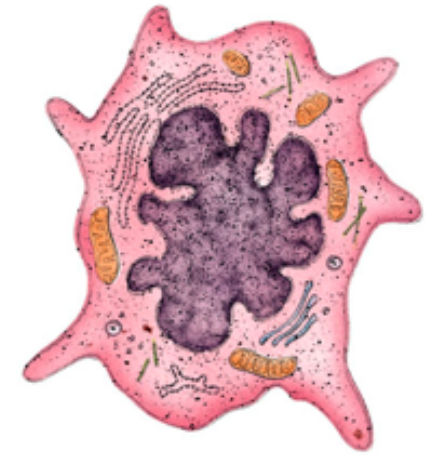


Fig.2: The epidermis and its cells.

3) Langerhans cells: involved in immune responses.



4) Merkel cells: which function in the sensation of touch along with the adjacent tactile discs (derived from a neuron).

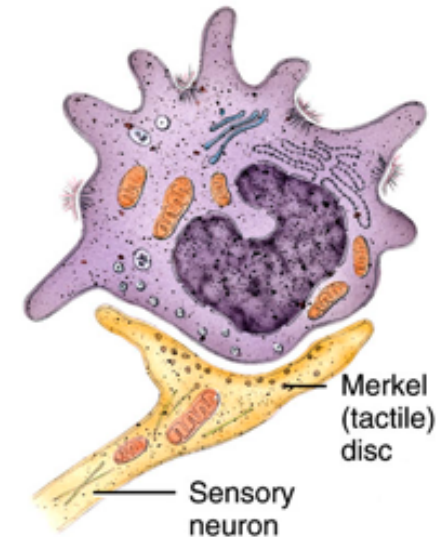
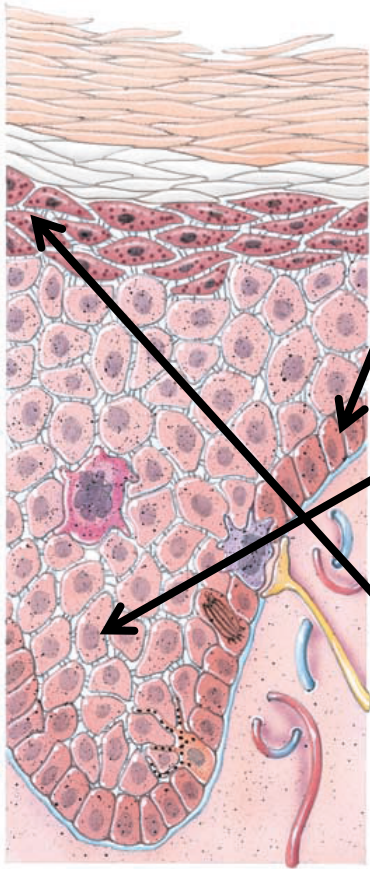


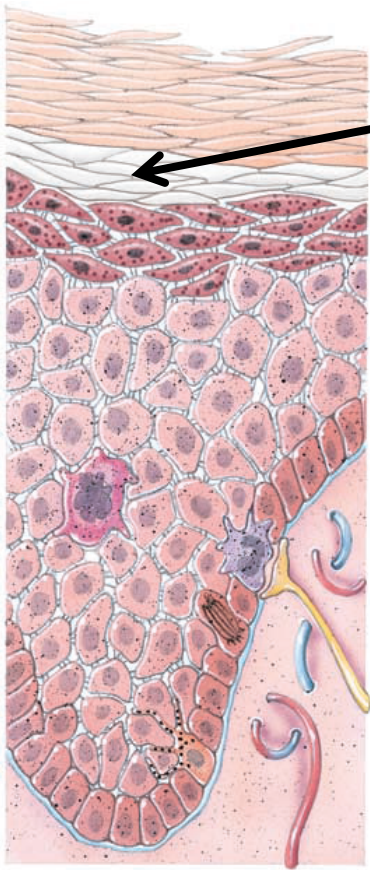
Fig.2: The epidermis and its cells (continued).

Layers of the Epidermis

- The epidermis is formed of four layers (**thin skin**) or five layers (**thick skin**).

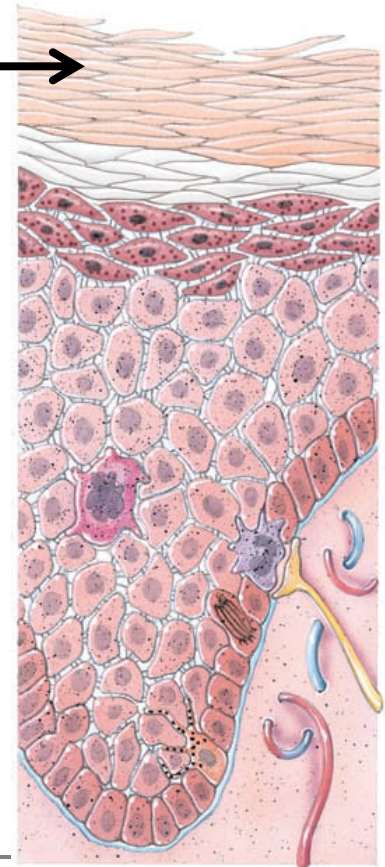


- 1) *Stratum basale* (deepest layer), where continuous cell division occurs to produce all the other layers.
- 2) *Stratum spinosum*, 8-10 layers of keratinocytes.
- 3) *Stratum granulosum*, which contains granules that could be keratohyalin or lamellar granules.



- 4) *Stratum lucidum* is present only in **thick skin** (the skin of the fingertips, palms, and soles).

- 5) *Stratum corneum (The Keratin layer)*: composed of many sublayers of flat, dead keratinocytes called **corneocytes** or **squames**. These are nothing more than cell membranes filled with keratin. They are continuously shed and are replaced by cells from deeper strata.



Notes about the layers:

- Merkel cells and the cell bodies of melanocytes are found within the stratum basale. The branches of melanocytes extend between adjacent keratinocytes to provide them with melanin pigment.

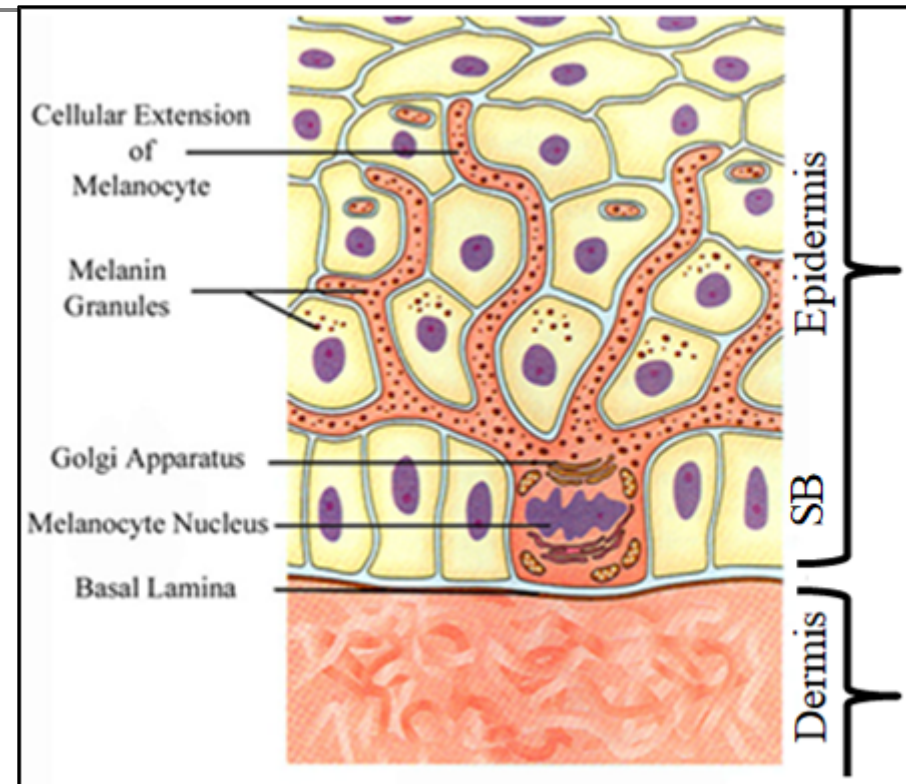


Fig.3: Position of melanocytes.

- The lamellar granules of the stratum granulosum bind with the cell membrane and release a lipid-rich secretion that fills spaces between cells to prevent water loss.
- Keratin in the cells bind to desmosomes to help in the adhesion of the cells to each other.

The Dermis

- The dermis is a layer of connective tissue that provides structural and nutritional support for the epidermis.
- Formed of two regions:
 1. Outer *papillary region* consists of loose (areolar) connective tissue containing:
 - *Dermal papillae* – tissue of the dermis that projects between the epidermal ridges (which are epidermal tissue passing down into the dermis). This increases the area of contact between the epidermis and dermis.
 - Capillary loops.
 - Corpuscles of touch and free nerve endings.

Fig.4: Papillary region of the dermis.

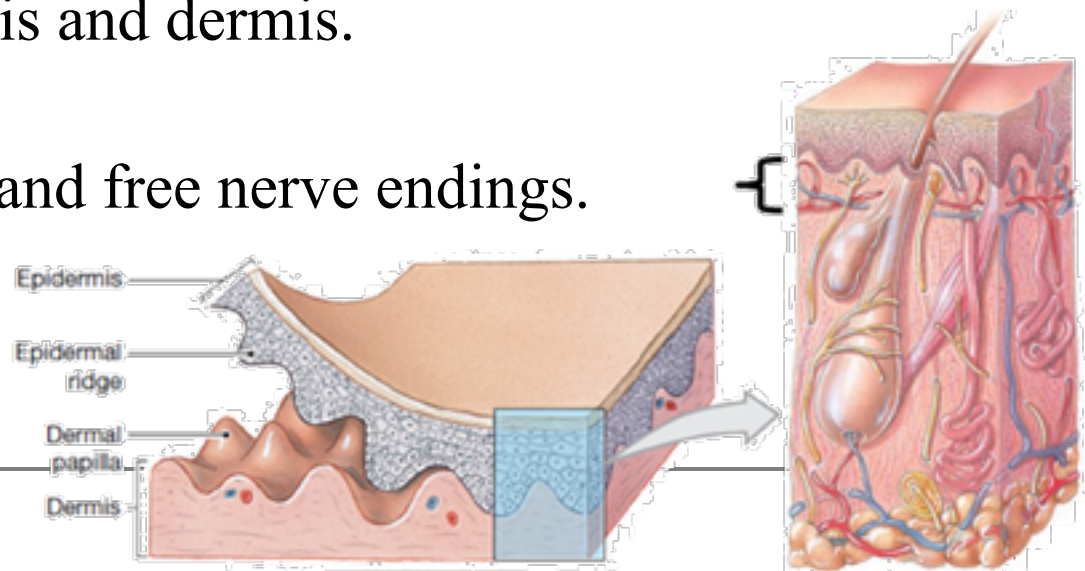




Fig.5: Fingerprint.

- The overlap between the dermis and the epidermis is reflected on the surface of the skin by a pattern of elevations and depressions that forms the **fingerprints** (and footprints). Their function is to increase firmness of grip by increasing friction.

2. The deeper *reticular region* consists of dense collagenous irregular connective tissue containing:

- Adipose cells
- Hair follicles
- Nerves
- Sebaceous (oil) glands, and sweat glands

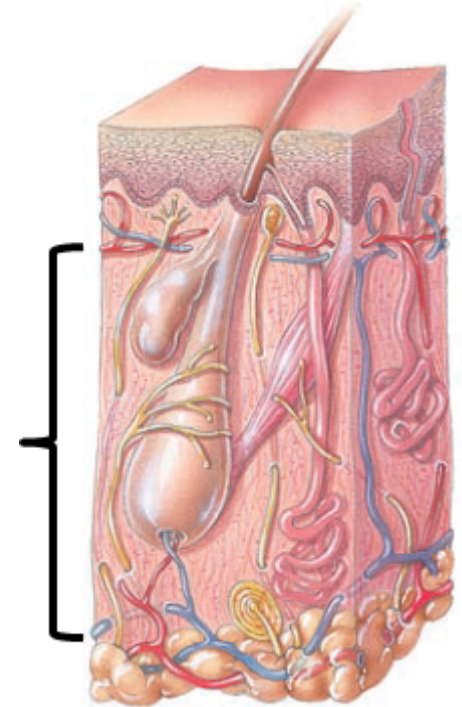


Fig.6: Reticular region of the dermis.

The Subcutaneous Tissue

- This layer (and sometimes the dermis) contains **lamellated (pacinian) corpuscles** which detect external pressure applied to the skin. It also contains various amounts of fatty tissue.
- Functions:
 - Attaches the skin to the underlying tissues and organs
 - Acts as an insulator
 - Serves as an energy storage site
 - Absorbs shocks (as in palms and soles)



Fig.7: Subcutaneous tissue.

Accessory Structures of the Skin

Hair (Pili)

- Hair is composed of columns of keratinized cells bonded together by extracellular proteins. It's present throughout the body, except in certain areas like the palms and soles.
- **Functions of hair:**
 - Protection (Hair on head protects scalp, eyelashes and eyebrows protect eye).
 - Reduction of heat loss.
 - Sensation of light touch.

Parts of the hair

- **The shaft**: the superficial part of the hair that extends beyond the surface of the skin.
- **The Root**: the deeper part of the hair that reaches down into the dermis. It's surrounded by the hair follicle which is a downward extension of the epidermis.
- The shaft and root of the hair are formed of 3 concentric layers:
 - 1) The medulla: The innermost layer
 - 2) The cortex: The middle layer
 - 3) The cuticle: The outermost layer. Formed of highly keratinized dead cells arranged like shingles on house roofs.

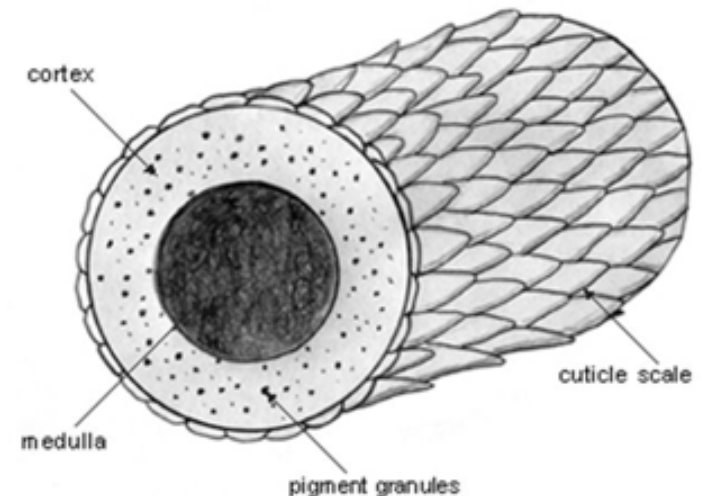
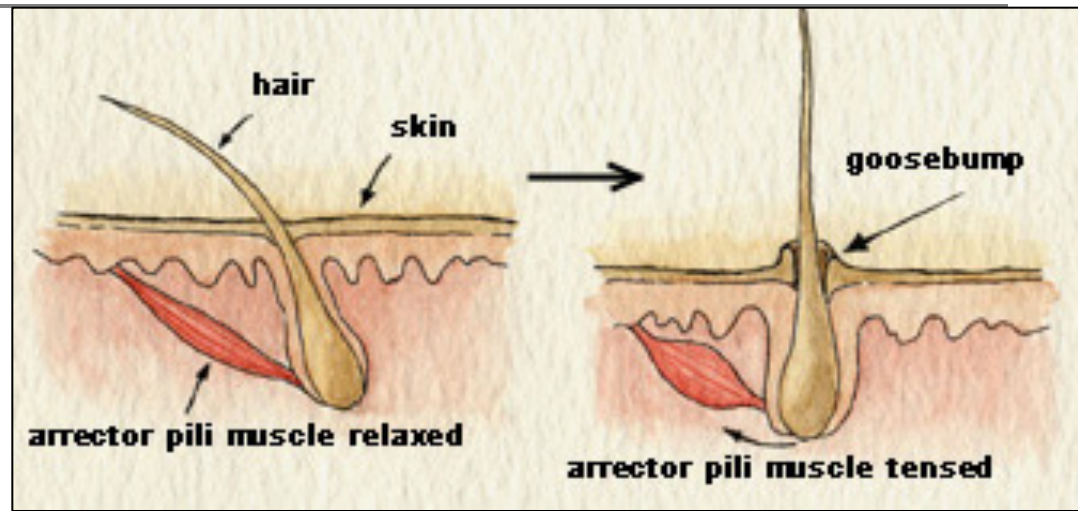


Fig.8: Layers of hair.

Fig.11: Action of the arrector pili muscle.



- The arrector pili muscle is a bundle of smooth muscle cells that extends from the superficial part of the dermis to the dermal sheath of the hair follicle. Under stressful conditions, the muscle contracts pulling the hair making the shaft perpendicular to the surface and bulging the skin around the hair producing ‘goosebumps’.
- The sebaceous gland is located in the angle between the arrector pili muscle and the hair. It opens into the hair follicle. The secretion of this gland (sebum) prevents dehydration and inhibits growth of certain bacteria.

Sweat Glands

Feature	Eccrine	Apocrine
Location	All over the body, specially palms and soles	Axilla, groin, and bearded facial regions of adult males
Shape	Coiled	Coiled
Secretion	Watery	More viscous (bacteria acts on this secretion to produce <i>body odor</i>)
Method of secretion	Merocrine	Merocrine
Opens	On the surface of the skin	Mostly into the hair follicle
Control	Nervous	Hormonal
Onset of action	From birth	At puberty
Functions	Helps cool the body. Elimination of waste products	Stimulated during emotional stress