

Integumentary System: Skin: epidermis, dermis

Lec. 8

Histology

Second year

Skin

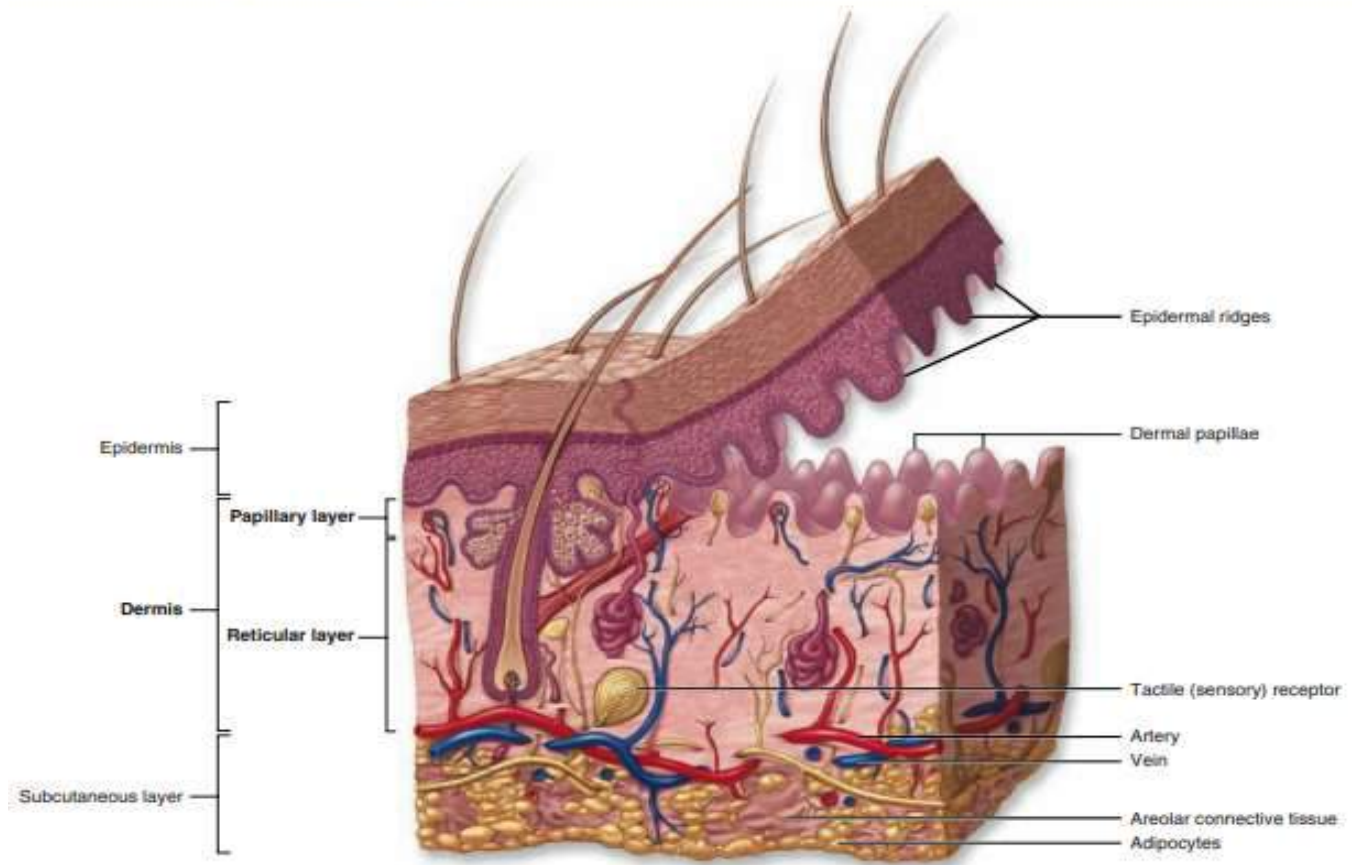
Also known as the **integument** or **cutaneous layer**, it is composed of epithelial layer (epidermis), and the dermis , a layer of connective tissue. Beneath the dermis lies the **subcutaneous tissue** or **hypodermis**.

Functions of skin;-

- 1. Protective:** It provides a **physical barrier** against thermal and mechanical insults and against most potential pathogens and other material, its act as **permeability barrier** against excessive loss or uptake of water. It allows drugs & medications to be administered via skin patches.
- 2. Sensory:** sensory receptors allow skin to constantly monitor the environment & help regulate the body's interactions with physical objects.
- 3. Thermoregulatory:** by sweating & hair cover
- 4. Metabolic:** Cells of skin synthesize vitamin D3, Excess electrolytes can be removed in sweat.
- 5. Sexual signaling:** Many features of skin, such as pigmentation and hair, are involved in attraction between the sexes. Also sex **pheromones** produced by the apocrine sweat glands are also important for this attraction.

Dermal papillae is a dermal projections interdigitate with epidermal invagination called **epidermal ridges** to strengthen adhesion of the two layers.

FIGURE 18-1 Layers and appendages of skin.



Diagrammatic overview of skin, showing the major layers and epidermal appendages (hair follicles, sweat, and

sebaceous glands), the vasculature, and the major sensory receptors.

EPIDERMIS

The epidermis consists mainly of a **stratified squamous keratinized epithelium** composed of cells called

1. **keratinocytes**. There are also three much less abundant epidermal cell types:
2. pigment-producing **melanocytes**. Its found among the cells of the basal layer and in hair follicles, producing the pigment **melanin** which responsible for the skin color & protects cell nuclei from ultraviolet (UV) radiation.
3. antigen-presenting **Langerhans cells**
4. tactile epithelial cells called **Merkel cells**

The epidermis forms the major distinction between thick skin, found on the **palms** and **soles**, and thin skin found elsewhere on the body.

Epidermis: It consists of a **keratinized stratified squamous epithelium** composed of 5 layers of cells;-

1. **stratum basale**
2. **stratum spinosum**
3. **stratum granulosum.**
4. **Stratum lucidum**
5. **Stratum corneum**

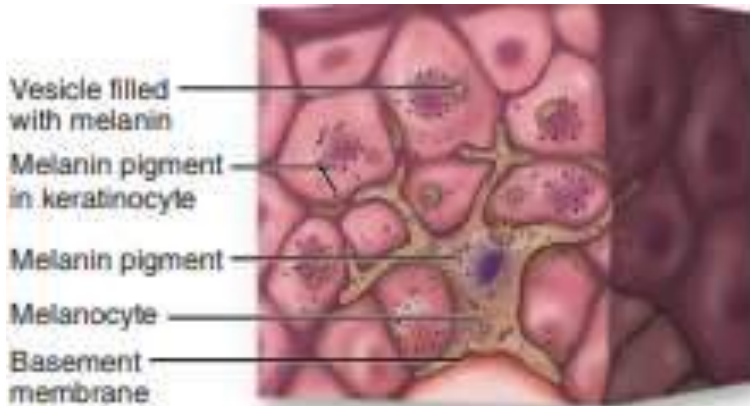
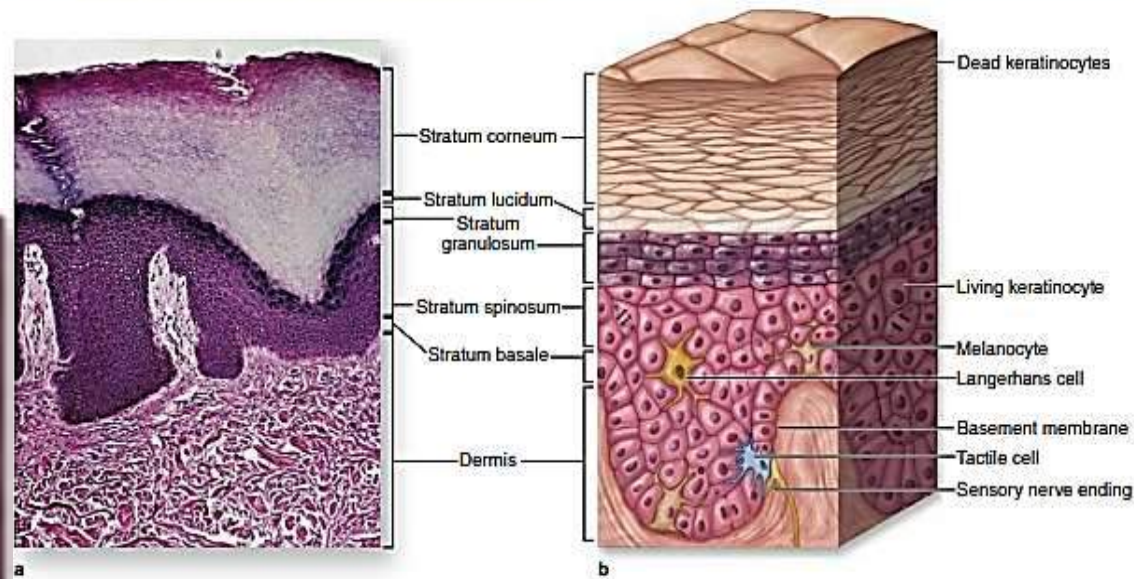


FIGURE 18-2 Layers (strata) of epidermis in thick skin.



From the dermis, the epidermis consists of four layers of keratinocytes

1. The basal layer (stratum basale) is a single layer of basophilic cuboidal or columnar cells on the basement membrane at the dermal-epidermal junction. The stratum basale is characterized by intense mitotic activity and contains, progenitor cells for all the epidermal layers. In addition to the basal stem cells for keratinocytes found here, a niche for such cells also occurs in the hair follicle sheaths that are continuous with the epidermis. The human epidermis is renewed about every **15-30 days**, depending on :

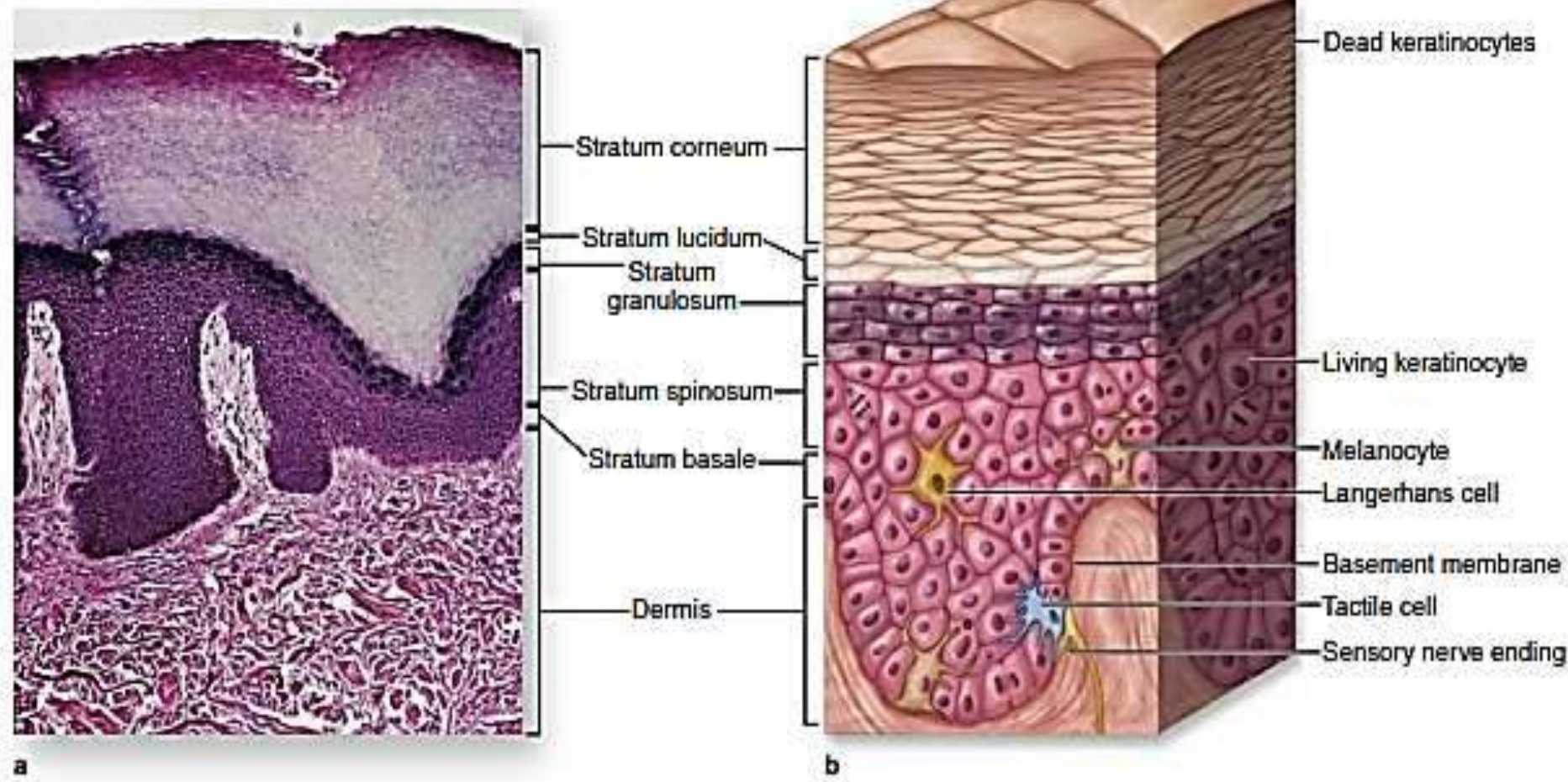
- 2. age,**
- 3. the region of the body,**
- 4. and other factors.**

2. **The spinous layer (stratum spinosum)** is normally the thickest layer, especially in the epidermal ridges, and consists of generally polyhedral cells having central nuclei with nucleoli and **cytoplasm actively synthesizing keratins**. Just above the basal layer, some cells may still divide and this combined zone is sometimes called the **stratum germinativum**. The keratin filaments assemble here into microscopically visible bundles called **tonofibrils** that converge and terminate at the numerous desmosomes holding the cell layers together. The cells extend slightly around the tonofibrils on both sides of each desmosome, leading to the appearance of many short “spines” or prickles at the cell surfaces. The epidermis of thick skin subject to continuous friction and pressure (such as the foot soles) has a thicker stratum spinosum with more abundant tonofibrils and desmosomes.

3. **The granular layer (stratum granulosum)** consists of three to five layers of flattened cells, now undergoing the terminal differentiation process of **keratinization**. Their cytoplasm is filled with basophilic masses called **keratohyaline granules**. These are dense, non-membrane-bound masses of **filaggrin** and other proteins associated with the **keratins of tonofibrils**, linking them further into large cytoplasmic structures. Characteristic features in cells of the granular layer also include Golgi-derived lamellar granules, small ovoid structures with many lamellae containing various lipids and glycolipids. Among the last activities of the keratinocytes, the lamellar granules undergo exocytosis, producing a **lipid-rich, impermeable layer around the cells**. This material forms a major part of the **skin's barrier** against water loss.

4. **The stratum lucidum**, found only in thick skin, consists of a thin, translucent layer of flattened eosinophilic keratinocytes held together by desmosomes. Nuclei and organelles have been lost, and the cytoplasm consists almost exclusively of packed keratin filaments embedded in an electron-dense matrix.
5. **The stratum corneum** consists of **15-20 layers of squamous, keratinized cells** filled with birefringent filamentous keratins. Keratin filaments contain at least six different polypeptides, synthesized during cell differentiation in the immature layers. As they form, keratin tonofibrils become heavily massed with filaggrin and other proteins in keratohyaline granules. By the end of keratinization, the cells contain only amorphous, fibrillar proteins with plasma membranes surrounded by the lipid-rich layer. These fully keratinized or cornified cells called **squames** are continuously shed at the epidermal surface as the desmosomes and lipid-rich cell envelopes break down.

FIGURE 18-2 Layers (strata) of epidermis in thick skin.



(a) Micrograph shows the sequence of the epidermal layers in thick skin and the approximate sizes and shape of keratinocytes in these layers. Also shown are the coarse bundles of collagen in the dermis and on the far left, the duct from a sweat gland entering the epidermis from a dermal papilla and coiling to a surface pore through all the strata. (X100; H&E)

(b) Diagram illustrating the sequence of the epidermal layers also indicates the normal locations of three important nonkeratinocyte cells in the epidermis: melanocytes, a Langerhans cell, and a tactile Merkel cell.

Dermis

- It is the layer of **connective tissue**, that supports the epidermis and binds it to the **subcutaneous tissue (hypodermis)**.
- Its thickness is varies with the region of the body & reaches its maximum of 4 mm on the back. The surface of the dermis is very **irregular**, **the dermal papillae** interdigitate with projections epidermal pegs or ridges of the epidermis, especially in skin subject to frequent pressure.
- A **basement membrane** between the stratum basale and the dermis. It consisting of the **basal lamina** and the **reticular lamina**. Nutrients for keratinocytes **diffuse** into the avascular epidermis from the dermal vasculature through this **basement membrane**.

The dermis contains two sublayers :-




- 1. papillary layer**, which includes the dermal papillae, consists of **loose connective tissue**, with types I and III **collagen fibers**, **fibroblasts** and scattered **mast cells**, **macrophages**, and other leukocytes.
- 2. Reticular layer**, consists of **dense irregular connective tissue**, with more fibers and fewer cells than the papillary layer, **elastic fibers** is also present, providing elasticity to the skin.

Both dermal regions contain a rich network of blood and lymphatic vessels. Nutritive vessels form two major plexuses (Table 18–1):

1. Between the papillary and reticular dermal layers lies the microvascular **subpapillary plexus**, from which capillary branches extend into the dermal papillae and form a rich, nutritive capillary network just below the **epidermis**.
2. A deep plexus with larger blood and lymphatic vessels lies near the interface of **the dermis** and the **subcutaneous layer**.

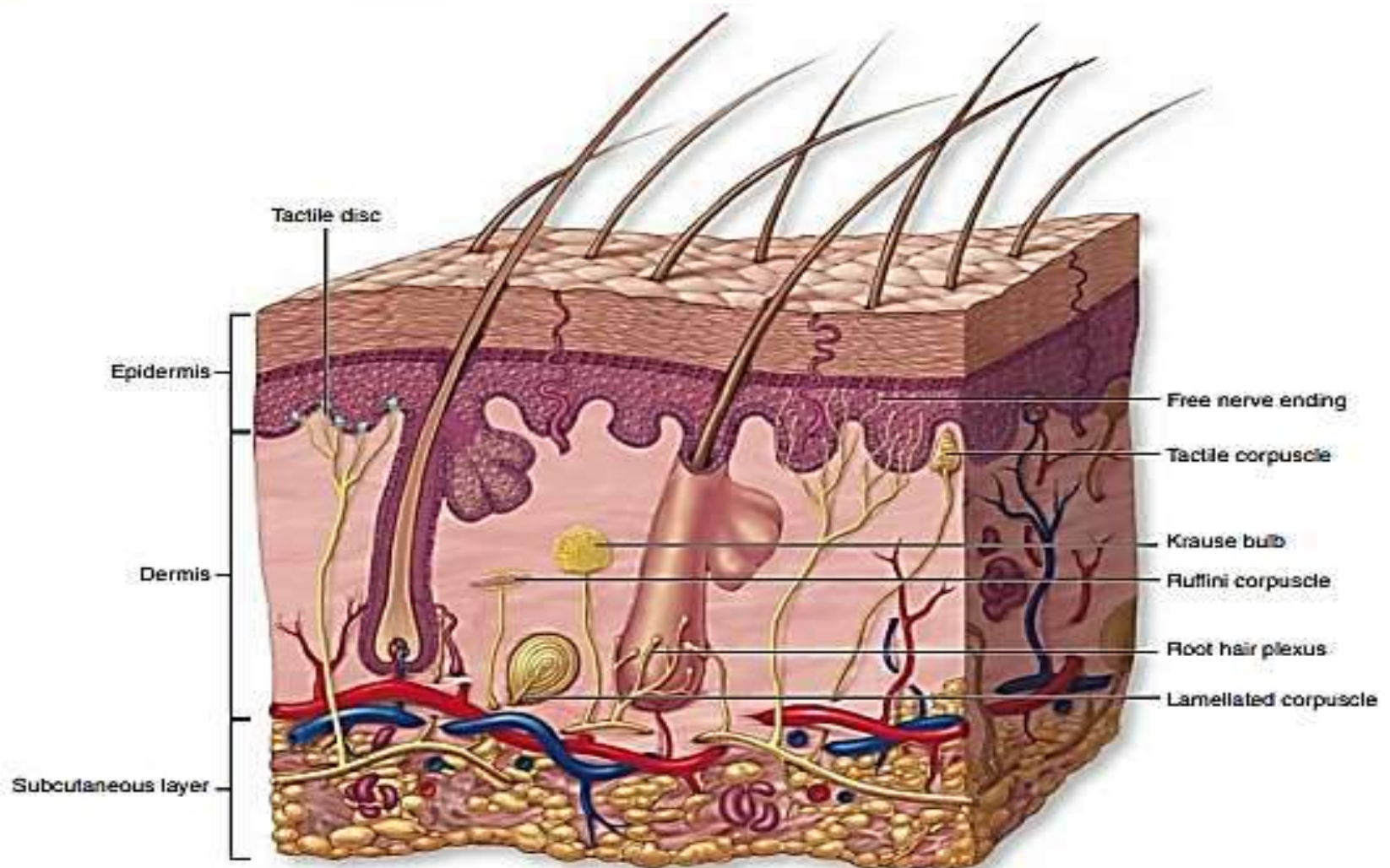
TABLE 18-1

Summary of skin and subcutaneous layers.

Layer	Specific Layer	Description
Epidermis	Stratum corneum	Most superficial layer; 20-30 layers of dead, flattened, anucleate, keratin-filled keratinocytes; protects against friction and water loss
	Stratum lucidum	2-3 layers of anucleate, dead cells; seen only in thick skin
	Stratum granulosum	3-5 layers of keratinocytes with distinct kerato-hyaline granules
	Stratum spinosum	Several layers of keratinocytes all joined by desmosomes; Langerhans cells present
	Stratum basale	Deepest, single layer of cuboidal to low columnar cells in contact with basement membrane; mitosis occurs here; melanocytes and Merkel cells also
		
Dermis	Papillary layer	More superficial layer of dermis; composed of areolar connective tissue; forms dermal papillae; contains subpapillary vascular plexus
	Reticular layer	Deeper layer of dermis; dense irregular connective tissue surrounding hair follicles, sebaceous glands and sweat glands, nerves, and deep plexus of blood vessels extending into subcutaneous layer
		
Subcutaneous layer	No specific layers	Not considered part of the integument; deep to dermis; composed of areolar and adipose connective tissue
		

- The dermis is also richly innervated. **Sensory afferent nerve fibers** form a network in the **papillary dermis** and around **hair follicles**, ending at epithelial and dermal receptors shown in Figure 18–11. Autonomic effector nerves to dermal sweat glands and smooth muscle fibers in the skin of some areas are **postganglionic fibers of sympathetic ganglia**; **no parasympathetic innervation is present.**

FIGURE 18–11 Tactile receptors.



Skin contains several types of **sensory receptors**, with or without capsules of collagen and modified Schwann cells. Most are difficult to see in routine preparations. In the epidermis are **free nerve endings** and tactile discs of nerve fibers associated with **Merkel cells** in the basal layer. Both have unencapsulated nerve fibers, as does the **root hair plexus** around the bases of hair follicles in the dermis. They detect light touch or movement of hair, although epidermal free nerve endings also detect pain and temperature

More complex, encapsulated tactile receptors are located in the dermis and hypodermis, and include **Meissner corpuscles** for light touch, **lamellated (pacinian) corpuscles** detecting pressure and high-frequency vibration, **Krause end bulbs** for low-frequency vibrations/movements, and **Ruffini corpuscles** detecting tissue distortion. The latter two receptors are less widely distributed in skin and less commonly seen.