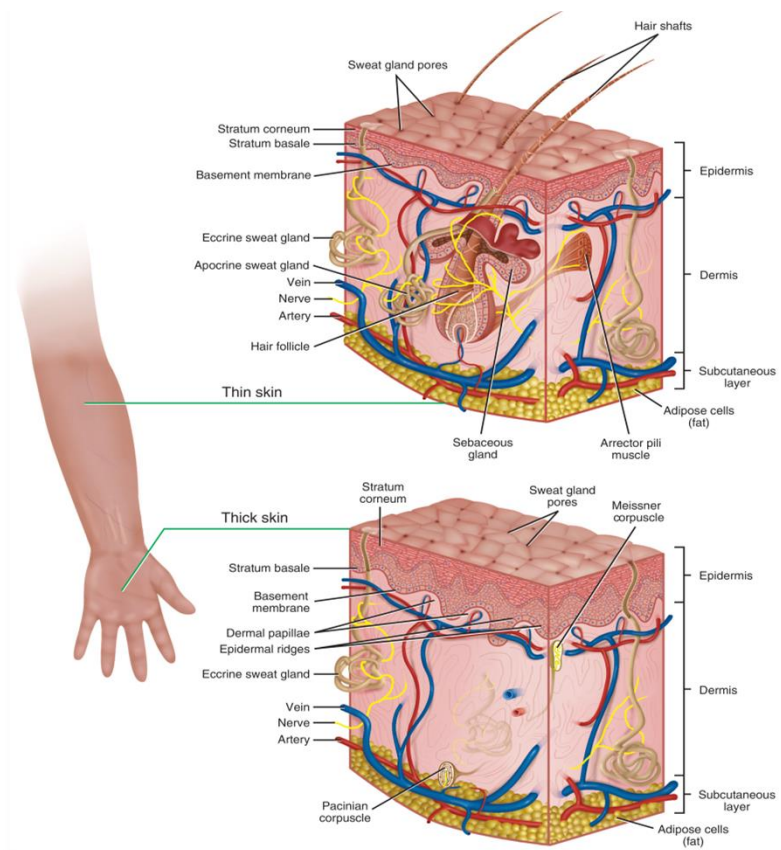


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Integumentary System

Skin is the largest organ in the body. Its derivatives and appendages form the integumentary system. In humans, skin derivatives include nails, hair, and several types of sweat and sebaceous glands. Skin, or integument, consists of two distinct regions, the superficial epidermis and a deep dermis. The surface layer of skin or the epidermis is nonvascular and lined by keratinized stratified squamous epithelium with distinct cell types and different cell layers. Inferior to the epidermis is the vascular dermis, characterized by dense irregular connective tissue, blood vessels, nerves, and different glands. In some areas of the body, numerous hair follicles are visible in the dermis. Beneath the dermis is hypodermis or a subcutaneous layer of connective tissue and adipose tissue that forms the superficial fascia seen in gross anatomy.



OVERVIEW FIGURE 12.1 ■ Comparison between thin skin in the arm and thick skin in the palm, including the contents of the connective tissue dermis.

Epidermal Cell Layers

Stratum Basale (Germinativum): The First Layer

- Deepest or basal single layer of cells that rests on the basement membrane.
- Cells attached by desmosomes and by hemidesmosomes to basement membrane.
- Cells serve as stem cells for epidermis and show increased mitotic activity.
- Cells mature migrate upward in epidermis and produce intermediate keratin filaments.

Stratum Spinosum: The Second Layer

- It is the layer above stratum basale that consists of four to six rows of cells.
- During histologic preparation, cells shrink and intercellular spaces appear as spines.
- Cells synthesize keratin filaments that become assembled into tonofilaments.
- Spines represent sites of desmosome attachments to keratin tonofilaments.

Stratum Granulosum: The Third Layer

- Cells are above stratum spinosum and consist of three to five cell layers of flattened cells.
- Cells filled with dense keratohyalin granules and membrane-bound lamellar granules.
- Keratohyalin granules consist of the protein filaggrin that cross-linked with keratin tonofilaments.
- Keratohyalin granules associate with keratin tonofilaments to produce soft keratin.

- Lamellar granules discharge lipid material between cells and waterproof the skin.

Stratum Lucidum: The Fourth Layer

- Lies superior to stratum granulosum, found in thick skin only, translucent and barely visible.

- Cells lack nuclei or organelles and are packed with keratin filaments.

Stratum Corneum: The Fifth Layer

- Most superficial layer and consists of flat, dead cells filled with soft keratin.

- Keratinized cells continually shed or desquamated and replaced by new cells.

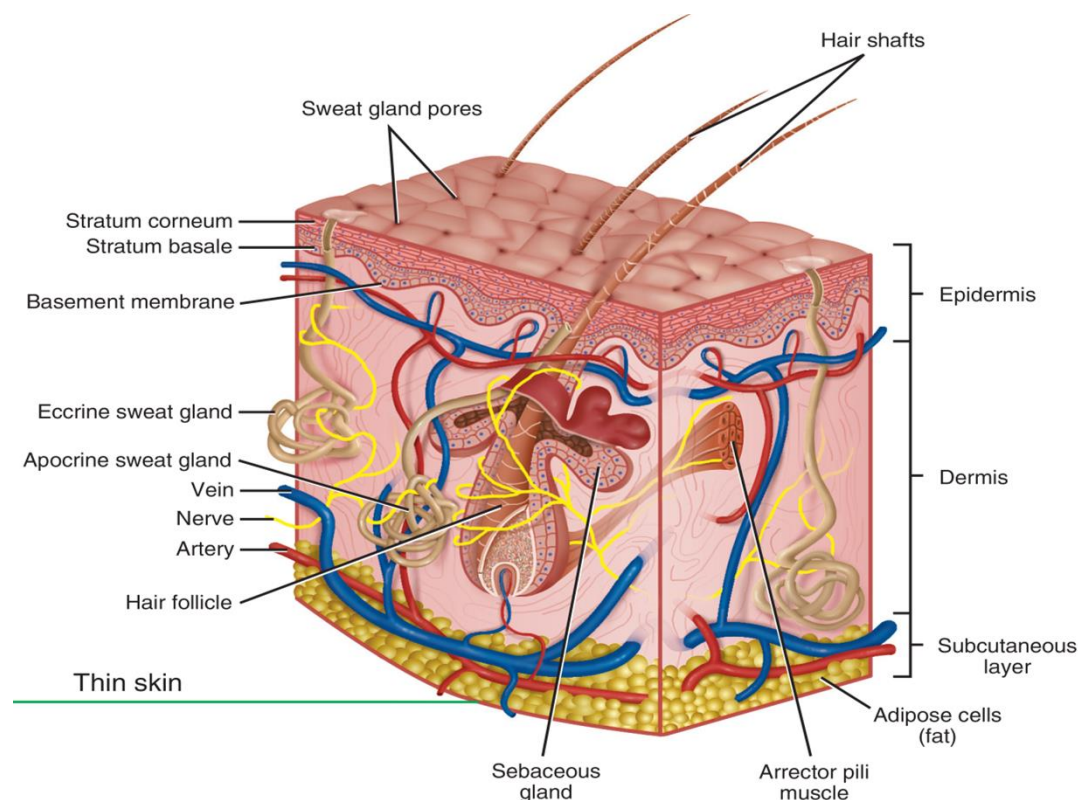
- During keratinization, hydrolytic enzymes eliminate nucleus and organelles.

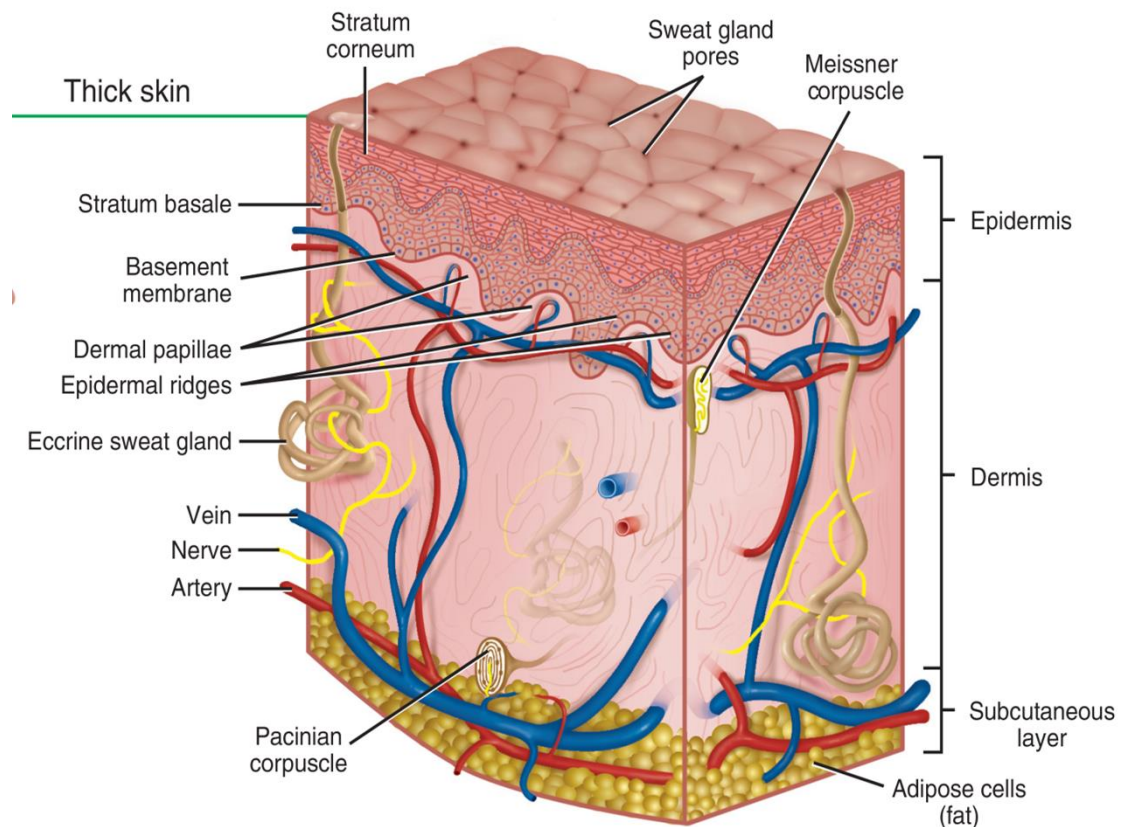
Dermis: Papillary and Reticular Layers

Dermis is the inferior connective tissue layer that binds to epidermis. A distinct basement membrane separates the epidermis from the dermis. In addition, dermis also contains epidermal derivatives such as the sweat glands, sebaceous glands, and hair follicles.

The junction of the dermis with the epidermis is irregular. The superficial layer of the dermis forms numerous raised projections called **dermal papillae**, which interdigitate with evaginations of epidermis, called **epidermal ridges**. This region of skin is the **papillary layer** of the dermis. This layer is filled with loose irregular connective tissue fibers, capillaries, blood vessels, fibroblasts, macrophages, and other loose connective tissue cells.

The deeper layer of dermis is called the reticular layer. This layer is thicker and is characterized by dense irregular connective tissue fibers (mainly type I collagen), and is less cellular than the papillary layer. There is no distinct boundary between the two dermal layers, and the papillary layer blends with the reticular layer. Also, dermis blends inferiorly with the hypodermis or the subcutaneous layer, which contains the superficial fascia and adipose tissue.





The connective tissue of the dermis is highly vascular and contains numerous blood vessels, lymph vessels, and nerves. Certain regions of skin exhibit **arteriovenous anastomoses** used for temperature regulation. Here, blood passes directly from arteries into veins. A more complex structure that also forms shunts is called a **glomus**. A glomus consists of a highly coiled arteriovenous shunt that is surrounded by collagenous connective tissue. The function of the glomus is also to regulate blood flow and conserve body heat. These structures are found in the fingertips, external ear, and other peripheral areas that are exposed to excessive cold temperatures and where arteriovenous shunts are needed.

In addition, the dermis contains numerous sensory receptors. **Meissner's corpuscles** are located closer to the surface of the skin in dermal papillae, whereas **Pacinian corpuscles** are found deeper in the connective tissue of the dermis. The Pacinian corpuscles are important sensory receptors for pressure, vibration, and touch.

Other Skin Cells

In addition to keratinocytes that form and become superficial layer of keratinized epithelium, the epidermis contains three less abundant cell types. These are melanocytes, Langerhans cells, and Merkel's cells. Unless skin is prepared with special stains, these cells are normally not distinguishable with hematoxylin and eosin preparations.

Melanocytes are derived from the neural crest cells. They have long irregular cytoplasmic extensions that branch into the epidermis. Melanocytes are located between the stratum basale and the stratum spinosum of the epidermis and synthesize the dark brown pigment **melanin**. Melanin is synthesized from the amino acid tyrosine by the melanocytes. The melanin granules in the melanocytes migrate to their cytoplasmic extensions, from which they are transferred to keratinocytes in the basal cell layers of the epidermis. Melanin imparts a dark color to the skin, and exposure of the skin to sunlight promotes increased synthesis of melanin. The function of melanin is to protect the skin from the damaging effects of ultraviolet radiation.

Langerhans cells are found mainly in the stratum spinosum. They participate in the body's immune responses. Langerhans cells recognize, phagocytose, and process foreign antigens, and then present them to T lymphocytes for an immune response. Thus, these cells function as antigen-presenting cells of the skin.

Merkel's cells are found in the basal layer of the epidermis and are most abundant in the fingertips. Because these cells are closely associated with afferent (sensory) unmyelinated axons, it is believed that they function as mechanoreceptors to detect pressure.