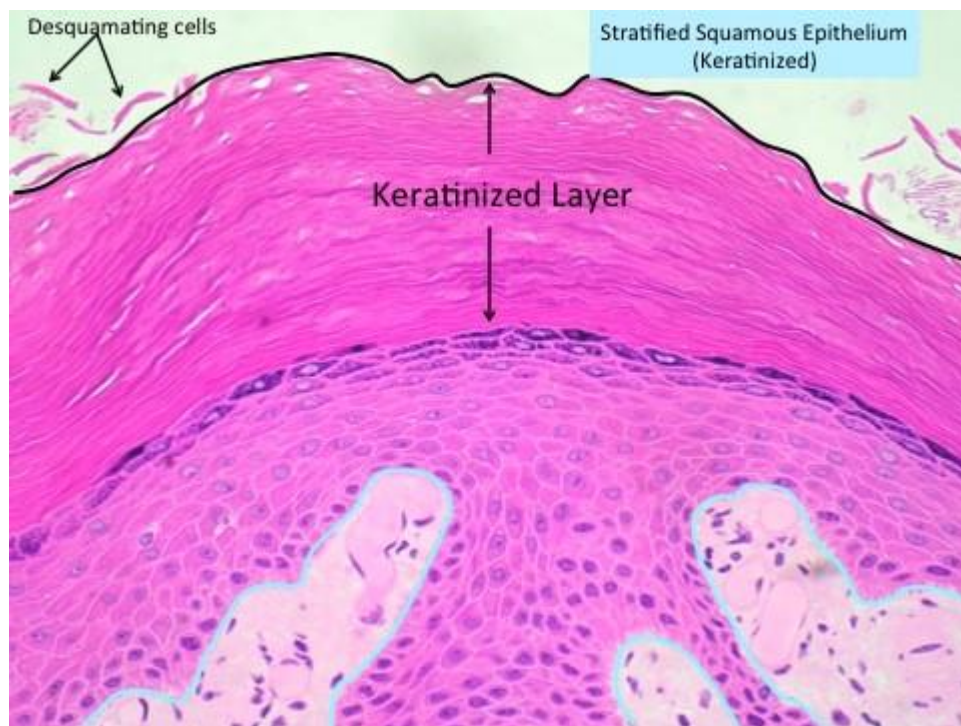


4.1.2

Composition of the Skin

Skin is composed of two layers of tissue, the outer epidermis and the inner dermis. Additionally, another layer resides under the dermis, the hypodermis, which is not technically a part of the integumentary system but will be discussed here due to its intimate relationship with the dermis.

Micrograph of the skin showing stratified squamous epithelium.



Stratified Squamous Epithelium in Skin. Image captured and labelled by BYU-Idaho Professor

Epidermis

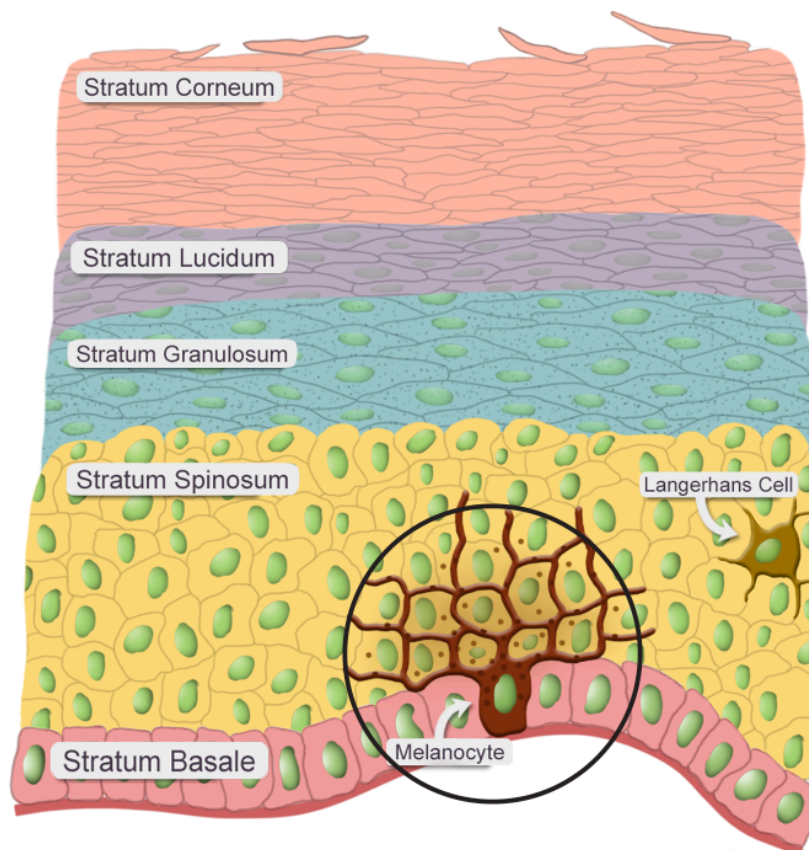
The epidermis is the outermost layer of the skin ("epi-" meaning "over" or "upon" in Greek). It is composed of stratified squamous epithelium and is separated from the deeper dermal layer by its basement membrane. Like all epithelial tissues, the epidermis is avascular. It receives nutrients and eliminates wastes via capillaries in the underlying dermis. Interestingly, it can obtain most of the oxygen required for cellular respiration directly from the atmosphere. Its thickness varies considerably. It is thinnest in the skin of the eyelids (0.05 mm) and thickest on the soles of the feet and palms of the hands (1.5 mm).

Four types of cells can be found in the epidermis. By far the most numerous are the **keratinocytes**. These are the cells of the stratified squamous epithelium. They get their name from keratin, a structural protein that gives strength to the

epidermis. Keratinocytes are constantly replaced as they slough off of the most superficial layer. It takes 25 - 45 days for the cells from the bottom epithelial layer to mature, die, and become components of the most superficial layer. Scattered among the keratinocytes are three other cell types. The **melanocytes** produce melanin, the pigment that gives skin its color. The term melanin comes from the Greek root *melas* meaning dark or black. **Langerhans** cells are dendritic cells that are derived from monocytes and play an important role in our immune system. Finally, **Merkel** cells are a component of the Merkel's discs that function as touch receptors.

There are five layers of the epidermis. Cells are produced in the deepest layer by the mitosis of stem cells. The new cells push older cells upward. Once the cells reach the most superficial layer they are shed. This process is also known as **desquamation**. As the cells move toward the top layer of the skin they undergo changes that eventually result in a cell that is basically a bag of keratin. This process is called **keratinization**. In the most superficial layer of the skin, the dead keratinized cells form a strong, durable layer that is waterproof and protects against abrasion. Psoriasis is a skin condition in which the process of keratinization occurs too quickly causing the skin to become scaly as an excess of dead cells accumulate near the outermost layers of skin.

As the process of keratinization takes place, the characteristics of the cells gradually change. When observed under the microscope the changing characteristics result in the formation of different layers or strata. Five different strata are observed. These strata or layers have unique names, and each name begins with the word **stratum** (Latin *stra'tum* meaning "covering"). Each layer of the epidermis varies in number of cells and not all regions of the skin possess all five layers.



Layers of the Epidermis. Image drawn by BYU-Idaho student Tabitha Daughtery

Stratum Basale: The stratum basale (basa' le) is the deepest layer of the epidermis. This layer is composed of a single layer of keratinocytes that are typically cuboidal or columnar in shape. These cells function as stem cells and undergo mitosis to generate new cells. Individual cells divide approximately every 19 days. As these cells divide, one of the daughter cells remains a stem cell to divide again while the other pushes the older cells toward the surface. It will take

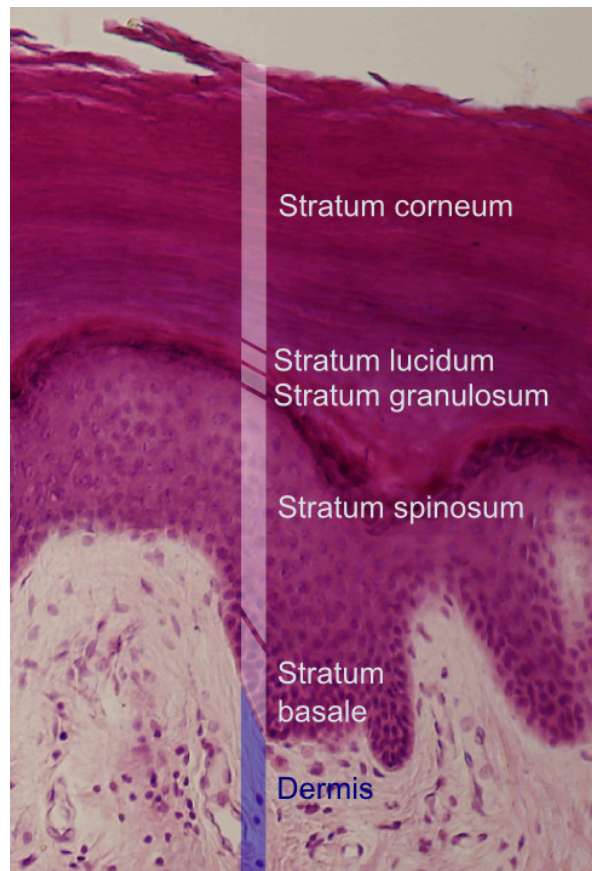
about a month and a half for the newly formed cell to reach the surface of the epidermis. To provide the structure the keratinocytes are anchored to each other by **desmosomes** and to the basement membrane by **hemidesmosomes**. Scattered among the keratinocytes of the stratum basale are the melanocytes. These cells produce the melanin that gives skin its color as well as protects the body from the damage of ultraviolet light. Although the melanocytes are attached to the basement membrane they have long processes that extend out between the keratinocytes in the first several layers of cells of the next stratum. The melanocytes make up about 10-25% of the cells in the stratum basale. In the image above the red line at the bottom represents the basement membrane and the stratum basale is the layer of cells attached to it.

Stratum Spinosum: Lying just above the stratum basale is the stratum spinosum. This stratum is composed of 8-10 layers of cells. In the image above the stratum spinosum extends from the stratum basale to the dark row of cells, the stratum granulosum. Notice that as the cells move from the basale to the granulosum the cells transition from cuboidal shaped cells to squamous shaped cells. Although not obvious in the figure above, the cells in this layer often have a spiny appearance. This is actually an artifact of the preparation of the microscope slides. As the cells lose water and shrink, the desmosomes between the cells remain intact, creating the spiny appearance. Cells in this layer begin to produce more of the intermediate filament **keratin**, giving the cells increased strength. In addition, lipid filled vesicles called lamellar bodies begin to form. The Langerhan cells are found primarily in this layer.

Stratum Granulosum: As the cells move into the next layer, the stratum granulosum, keratohyalin granules form in the cytoplasm of the cell. The presence of these granules gives this layer its name. In the image above the stratum granulosum can be seen as the dark layer of cells that is 2-5 cells thick. Other changes in the cells that occur as they pass through this layer include the following 1) Formation of a protein envelope just under the plasma membrane. 2) The release of the lamellar bodies into the extracellular space. The lipid that is released from the lamellar bodies helps make the skin water resistant. 3) The nucleus and most other organelles degenerate.

Stratum Lucidum: The cells in the stratum lucidum form a layer between 2-6 cells deep. The cells in this layer appear clear or translucent. The keratohyalin granules have dispersed around the keratin filaments giving the cells their clear appearance. This layer is not present in all skin but is unique to certain areas of the body (we will discuss its distribution in the section on thick and thin skin). Some consider the stratum lucidum to be a subdivision of the stratum corneum.

Stratum Corneum: The most superficial layer of the epidermis is known as the stratum corneum. This layer is 25-30 layers of **cornified cells** and makes up as much as 75% of the thickness of the epidermis. As seen in the image above, the cells lack nuclei and are essentially protein bags filled with keratin. These cells are extremely tough, allowing them to protect the body against abrasion. Two kinds of keratin exist on our bodies: soft keratin and hard keratin. Soft keratin is found in the cells of the skin, whereas hard keratin can be found in the nails and hair. The desmosomes of the surface cells gradually break apart which leads these cells being desquamated. As mentioned earlier, the average person sheds about 40 pounds of dead skin cells in their lifetime. Look at a labeled picture of the [epidermal layers](#).

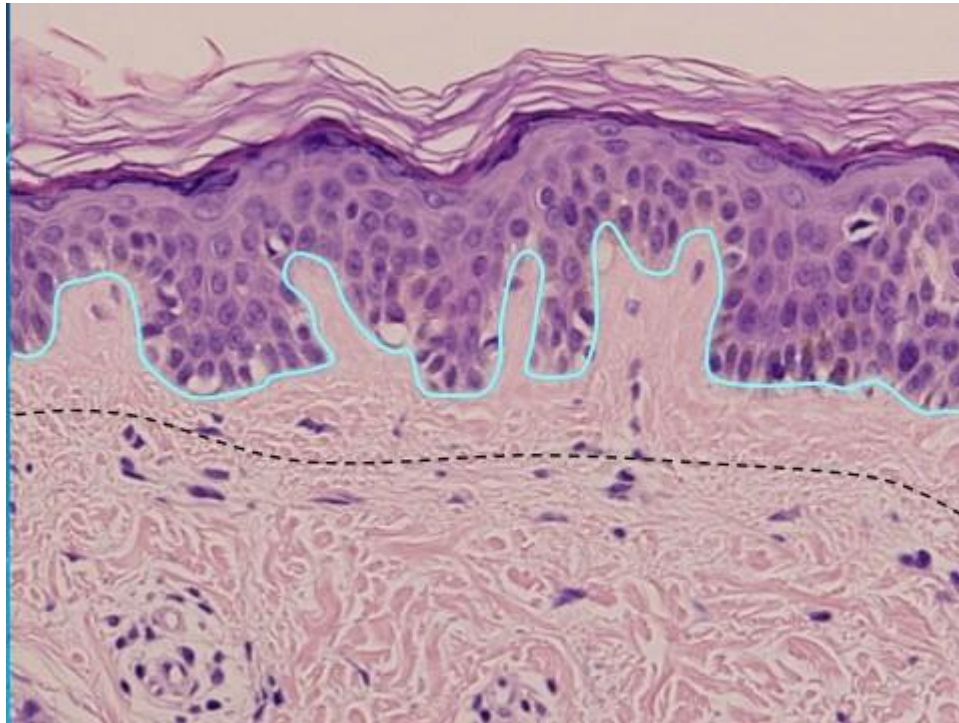


Layers of the Epidermis.

By Mikael Häggström, based on work by Wbensmith ;License: [CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0>)Link: https://upload.wikimedia.org/wikipedia/commons/e/e4/Epidermal_layers.png]

Dermis

Directly beneath the epidermis lays the flexible, cushioning **dermis**. The dermis is made up of mostly collagen fibers. However, elastin and reticular fibers are also present in this layer. The dermis is much thicker than the epidermis, ranging from 0.5 – 4.0 mm thick (a dime is approximately 1.3 mm thick). The majority of our sensations are perceived by nerve endings and hair follicle receptors located in the dermis. Blood vessels are also located in the dermis, though they are more abundant in the hypodermis. The dermis houses hair follicles and sebaceous glands as well (discussed below). The dermis is made up of two layers: the **papillary layer** and the **reticular layer**. The image below is a micrograph of the skin. The epidermis is visible on the upper portion of the slide with the dermis below. The dashed line represents the boundary between the papillary and reticular layers of the dermis and the blue line represents the basement membrane of the epidermis.



Micrograph of skin showing the papillary and reticular layers of the dermis. Image captured by BYU-Idaho Professor

Papillary layer: The papillary layer is the more superficial layer. It gets its name from the **dermal papillae** (papilla = a nipple like process) that protrude up into the epidermis accounting for the wavy nature of the epidermal basement membrane. The papillary layer is made up of loose fibrous connective tissue. Due to this layer's direct contact with the epidermis, the papillary layer provides nutrients from its vasculature as well as assisting in temperature regulation and excretion. This layer is represented by the lighter pink tissue above the dotted line but below the blue line in the image above.

Reticular layer: The deeper **reticular layer** forms the bulk of the dermis. It is composed of dense fibrous connective tissue. Recall that dense fibrous connective tissue comes in two varieties, regularly and irregularly arranged, based on the orientation of the collagen fibers that make up the bulk of these tissues. The reticular layer of the dermis is made of the latter variety and its fibers run in all directions creating a structure that can withstand stresses in all directions. This tough, resilient reticular layer of animals is made into leather when properly prepared, attesting to its strength. In the image above the collagen fibers are the thick, pink structures in the lower half of the slide. Even though they are randomly arranged, there is still a "general" direction to the fibers creating what are referred to as **cleavage or tension lines**. If the skin were to be cut at right angles to the cleavage lines, the wound would tend to gape open more and create a large scar when it heals. Conversely, if the skin were cut parallel to the cleavage lines, the wound would not gape open as much and would not scar as much when it heals. Make sure to take the time to look at the general direction of the [cleavage lines](#). Although the reticular layer is very strong, if stretched excessively, such as during pregnancy, small tears appear. This results in the formation of small scars called **striae**, or more commonly, stretch marks.

Hypodermis

The **hypodermis** or **subcutaneous tissue** ("hypo-" meaning "under" in Greek and "subcutaneous" meaning "under the skin" in Latin) lies just under the skin and is composed of loose connective tissue and adipose tissue. This tissue connects the skin with underlying bones or muscles. Roughly 50% of body fat can be found in the hypodermis. Owing to its layer of fatty tissue, the hypodermis provides protection, cushioning and insulation, as well as being a site for energy storage. The hypodermis is also a common site for the administration of injections as the blood supply allows for rapid uptake of the drugs.

Thick and Thin Skin

As mentioned previously, our skin varies in thickness. Depending on the number of strata we categorize the skin as either **thick skin** or **thin skin**.

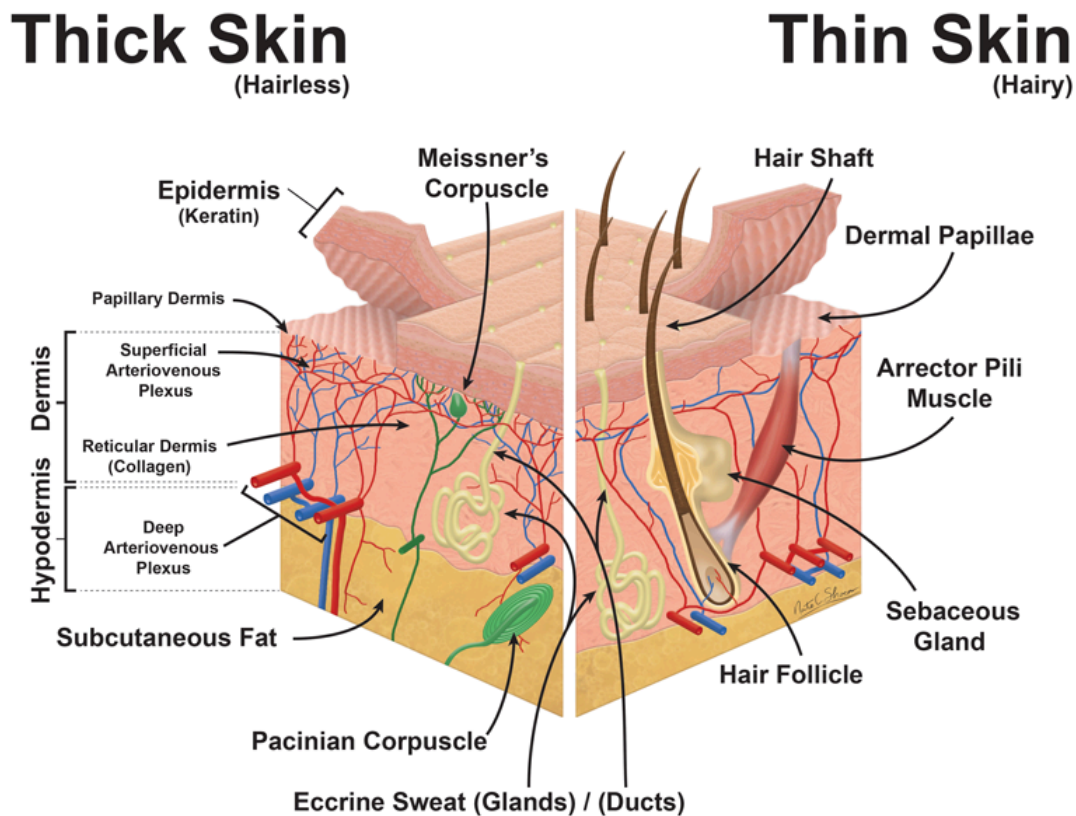


Image drawn by BYU-Idaho student Nathan Shoemaker Fall 2016

This image labels many of the structures found in both thick and thin skin. There are some differences however. Thick skin contains all 5 strata (thin skin is generally missing the stratum lucidum). Thick skin is found in areas routinely subjected to abrasion and pressure and is designed to protect against these stresses. Another characteristic of thick skin is that it does not have hair follicles or sebaceous glands and is found on the soles of the feet, the palms of the hands and the fingertips. Thick skin has ridges that form finger, palm, and toe prints. These prints are created by the dermal papillae arranged in unique parallel rows. The epidermis overlying these rows conforms to the shape of these ridges thus creating a fingerprint. Thin skin covers the majority of our body. It only has 4 strata, lacking the stratum lucidum. It contains hair follicles and sebaceous glands.

It is important to understand that the terms thick and thin pertain only to the thickness of the *epidermis*. The skin covering a human back has a total thickness that is greater than that covering the palms of the hands. However, the back is covered by thin skin (epidermis) while the palms of the hands are composed of thick skin (epidermis). Thus, the overall thickness of the skin on the back is greater due to increased thickness of the *dermis*. When either type of skin is subjected to inordinate amounts of friction and abrasion the thickness of the stratum corneum increases. These thickenings are known as **calluses**. Likewise, if the skin overlying a bone is subjected to pressure it will also increase in thickness forming a **corn**. Corns are capable of penetrating deep into the epidermis and may become very painful.



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