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## MEDICAL TERMINOLOGY FOR HEALTHCARE PROFESSIONS

### CONTENTS

# 5. Integumentary System

### *Learning Objectives*

- Examine the anatomy of the integumentary system
- Determine the main functions of the integumentary system
- Differentiate integumentary system medical terms and common abbreviations
- Discover medical specialties associated with the integumentary system
- Recognize common diseases, disorders, and procedures related to the integumentary system

# Integumentary System Word Parts

Click on prefixes, combining forms, and suffixes to reveal a list of word parts to memorize for the Integumentary System.

> **Prefixes**

> **Combining Forms**

> **Suffixes**

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H-P

## Introduction to the Integumentary System

The integumentary system refers to the skin and its accessory structures. In the adult human body, the skin makes up about 16% of body weight and covers an area of 1.5 to 2 m<sup>2</sup>.

In fact, the skin and accessory structures are the largest organ system in the human body. The skin protects your inner organs, and it is in need of daily care and protection to maintain its health.

*Did you know?*

The skin and accessory structures are the largest organ system in the human body.

Watch this video:

[Previous: Sensory Systems](#)

[Next: Skeletal System](#)

## The Integumentary System, Part 1 - Skin Deep: Crash Course Anatomy & Physiolo...



Media 5.1. [The Integumentary System, Part 1 – Skin Deep: Crash Course A&P #6](#) [Video].  
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## Practice Medical Terms Related to the Integumentary System



subcutaneous

 Turn

# Anatomy (Structures) of the Integumentary System

The skin and its accessory structures make up the integumentary system, which provides the body with overall protection. The skin is made of multiple layers of cells and tissues, which are held to underlying structures by connective tissue ([Figure 5.1](#)). The deeper layer of skin is well [vascularized](#). It also has numerous sensory [autonomic](#), and [sympathetic](#) nerve fibers ensuring communication to and from the brain.

The skin is composed of two main layers:

1. The [epidermis](#)

2. The [dermis](#)

1. Beneath the dermis lies the [hypodermis](#), also known as the subcutaneous layer.

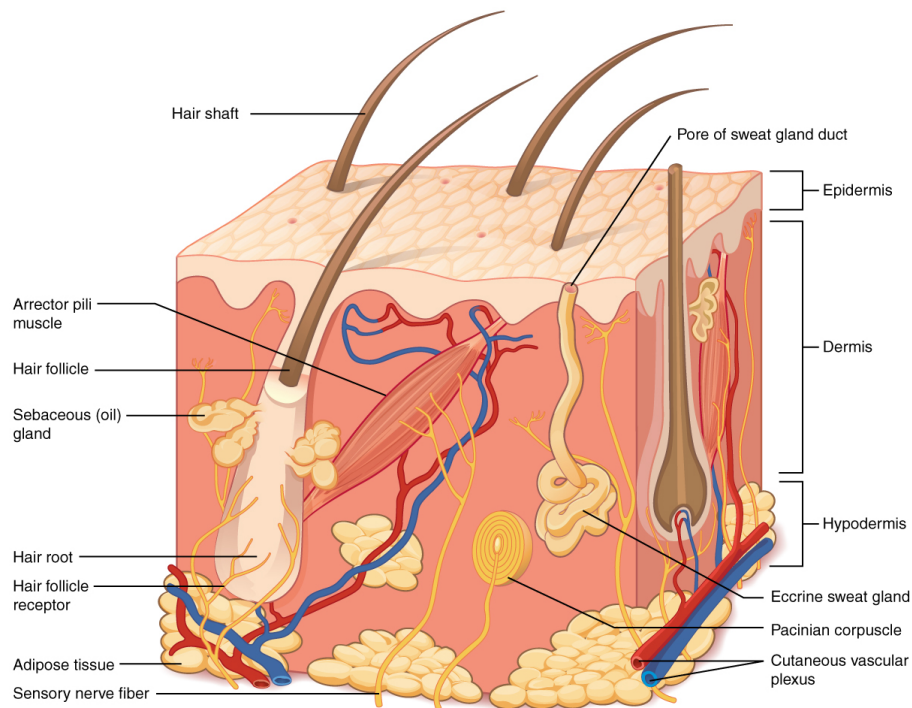


Figure 5.1 Layers of Skin. From Betts et al., 2013. Licensed under [CC BY 4.0](#). [[Image description.](#)]

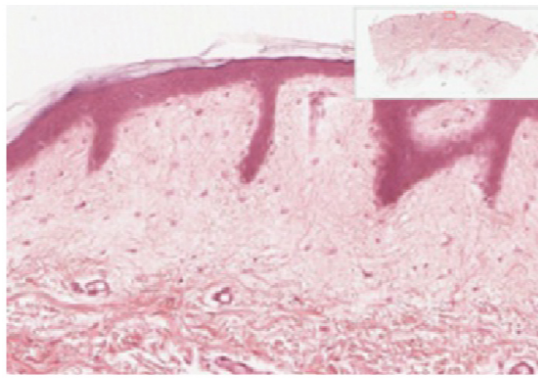
## Concept Check

- On the diagram above find the two layers of the skin: **epidermis** and **dermis**.
- The literal breakdown for **hypodermis** is “below the dermis.” On the diagram above, where can you locate it?
- Can you find a **hair follicle**, **hair root**, and **hair shaft**?
- Keep reading to find out what the **arrector pili muscle** does when you are frightened.

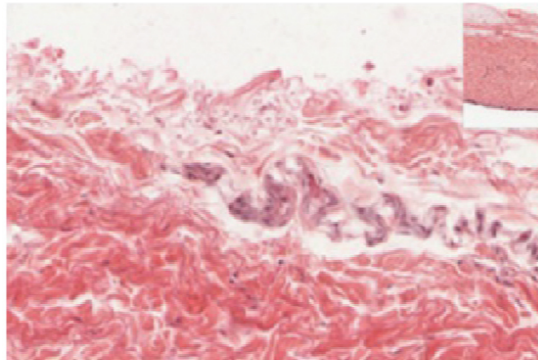
## Epidermis

The [epidermis](#) is composed of keratinized, stratified squamous epithelium. It is made of four or five layers of epithelial cells, depending on its location in the body. It is [avascular](#).

- **Thin skin** has four layers of cells. From deep to superficial, these layers are the [stratum basale](#), stratum spinosum, stratum granulosum, and stratum corneum. Most of the skin can be classified as thin skin.
- **Thick skin** is found only on the palms of the hands and the soles of the feet. It has a fifth layer, called the stratum lucidum, located between the stratum corneum and the stratum granulosum (see [Figure 5.2](#)).



(a)



(b)

Figure 5.2 Thin Skin versus Thick Skin. These slides show cross-sections of the epidermis and dermis of (a) thin and (b) thick skin. Note the significant difference in the thickness of the epithelial layer of the thick skin. From the top, LM  $\times$  40, LM  $\times$  40. (Micrographs provided by the Regents of University of Michigan Medical School  $\copyright$  2012). From Betts et al., 2013. Licensed under [CC BY 4.0](#). [[Image description](#).]

The cells in all of the layers except the stratum basale are called [keratinocytes](#). **Keratin** is an intracellular fibrous protein that gives hair, nails, and skin their hardness and water-resistant properties. The keratinocytes in the stratum corneum are dead and regularly slough away, being replaced by cells from the deeper layers (see [Figure 5.3](#)).

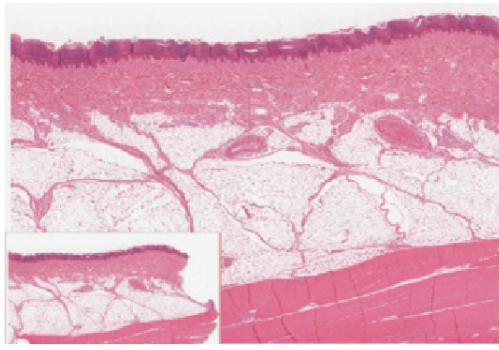


Figure 5.3 Epidermis. The epidermis is epithelium composed of multiple layers of cells. The basal layer consists of cuboidal cells, whereas the outer layers are squamous, keratinized cells, so the whole epithelium is often described as being keratinized stratified squamous epithelium. LM  $\times$  40. (Micrograph provided by the Regents of University of Michigan Medical School  $\copyright$  2012). From Betts et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

## Dermis

The dermis contains blood and lymph vessels, nerves, and other structures, such as hair follicles and sweat glands. The dermis is made of two layers (papillary layer and reticular layer) of connective tissue that compose an interconnected mesh of elastin and collagenous fibers, produced by fibroblasts (see [Figure 5.4](#)).



Figure 5.4 Layers of the Dermis. This stained slide shows the two components of the dermis—the papillary layer and the reticular layer. Both are made of connective tissue with fibers of collagen extending from one to the other, making the border between the two somewhat indistinct. The dermal papillae extending into the epidermis belong to the papillary layer, whereas the dense collagen fiber bundles below belong to the reticular layer. LM  $\times$  10. (credit: modification of work by “kilbad”/Wikimedia Commons). From Betts et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

## Papillary Layer

The papillary layer is made of loose, areolar connective tissue, which means the collagen and elastin fibers of this layer form a loose mesh. This superficial layer of the dermis projects into the stratum basale of the epidermis to form finger-like dermal papillae (see [Figure 5.4](#)). Within the papillary layer are fibroblasts, a small number of adipocytes, and an abundance of small blood vessels. In addition, the papillary layer contains [phagocytes](#) that help fight bacteria or other infections that have breached the skin. The layer also contains lymphatic capillaries, nerve fibers, and [Meissner corpuscles](#).



Underlying the papillary layer is the much thicker reticular layer, composed of dense, irregular connective tissue. The layer is well [vascularized](#) and has a rich sensory and [sympathetic](#) nerve supply. The reticular layer appears [reticulated](#) due to a tight meshwork of fibers. Elastin fibers provide some elasticity to the skin, enabling movement. Collagen fibers provide structure and tensile strength, with strands of collagen extending into both the papillary layer and the hypodermis. In addition, collagen binds water to keep the skin hydrated. Collagen injections and Retin-A creams help restore skin turgor by either introducing collagen externally or stimulating blood flow and repair of the dermis, respectively.

## Hypodermis (Subcutaneous Layer)

The [hypodermis](#), also known as the subcutaneous layer, serves to connect the skin to the underlying [fascia](#) of the bones and muscles. It is not strictly a part of the skin, although the border between the hypodermis and [dermis](#) can be difficult to distinguish. The hypodermis consists of well-vascularized, loose, areolar connective tissue and [adipose](#) tissue, which functions as a mode of fat storage and provides insulation and cushioning for the integument.

## Practice Labeling the Layers of the Skin



Pacinian corpuscle  
Cutaneous vascular plexus

sebaceous/oil gland	sensory nerve fiber	adipose tissue	dermis	hypodermis	epidermis	hair root
eccrine sweat gland	arrector pili muscle	pore of sweat gland	hair follicle	hair follicle	hair shaft	

Check

## Physiology (Function) of the Integumentary System

The skin and accessory structures perform a variety of essential functions, such as protecting the body from invasion by microorganisms, chemicals, and other environmental factors; preventing dehydration; acting as a sensory organ; modulating body temperature and electrolyte balance; and synthesizing vitamin D. The underlying hypodermis has important roles in storing fats, forming a “cushion” over underlying structures, and providing insulation from cold temperatures.

# Protection

The skin protects the body from wind, water, and UV sunlight. It acts as a protective barrier against water loss and it also is the first line of defense against abrasive activity such as grit, microbes, or harmful chemicals. Sweat excreted from sweat glands deters microbes from over-colonizing the skin surface by generating dermcidin, which has antibiotic properties.

# Sensory Function

The skin acts as a sense organ because the epidermis, dermis, and hypodermis contain specialized sensory nerve structures that detect touch, surface temperature, and pain. These receptors are more concentrated on the tips of the fingers, which are most sensitive to touch, especially the [Meissner corpuscle](#), which responds to light touch, and the [Pacinian corpuscle](#), which responds to vibration. Merkel cells, seen scattered in the stratum basale, are also touch receptors. In addition to these specialized receptors, there are sensory nerves connected to each hair follicle, pain and temperature receptors scattered throughout the skin, and motor nerves innervate the arrector pili muscles and glands. This rich innervation helps us sense our environment and react accordingly,

# Thermoregulation

The integumentary system helps regulate body temperature through its tight association with the [sympathetic nervous system](#). The sympathetic nervous system is continuously monitoring body temperature and initiating appropriate motor responses.

- When the **body becomes warm** sweat glands, accessory structures to the skin, secrete water, salt, and other substances to cool the body.
  - Even when the body does not appear to be noticeably sweating, approximately 500 mL of sweat are secreted a day.
- If the **body becomes excessively warm** due to high temperatures, vigorous activity, or a combination of the two, sweat glands will be stimulated by the sympathetic nervous system to produce large amounts of sweat.
  - When the sweat evaporates from the skin surface, the body is cooled as body heat is dissipated.
  - In addition to sweating, arterioles in the dermis dilate so that excess heat carried by the blood

- When **body temperatures drop**, the arterioles constrict to minimize heat loss, particularly in the ends of the digits and tip of the nose.
  - This reduced circulation can result in the skin taking on a whitish hue.
  - Although the temperature of the skin drops as a result, passive heat loss is prevented, and internal organs and structures remain warm.
  - If the temperature of the skin drops too much (such as environmental temperatures below freezing), the conservation of body core heat can result in [frostbite](#).

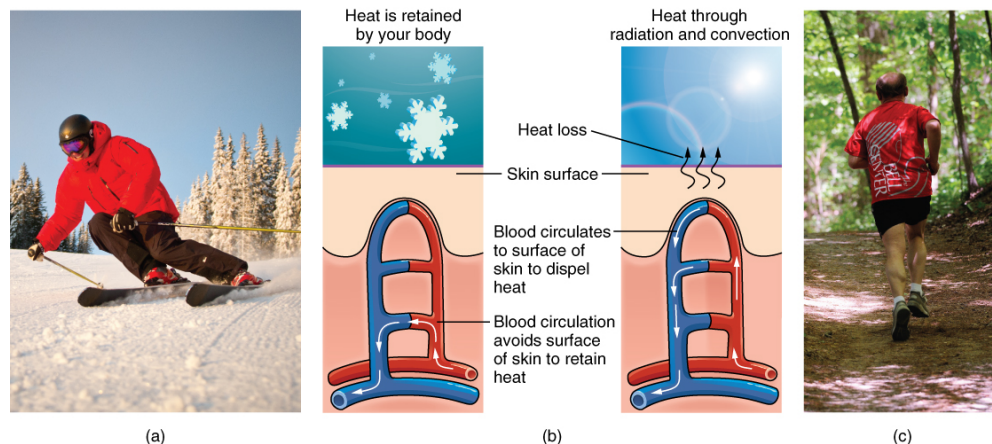


Figure 5.5 Thermoregulation. During strenuous physical activities, such as skiing (a) or running (c), the dermal blood vessels dilate and sweat secretion increases (b). These mechanisms prevent the body from overheating. In contrast, the dermal blood vessels constrict to minimize heat loss in response to low temperatures (b). (credit a: “Trysil”/Flickr; credit c: Ralph Daily). From Betts et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

## Concept Check

Can you describe the **thermoregulation** process between the integumentary system and the sympathetic system?

- What happens when the body temperature is too warm?
- What happens when the body temperature is too cold?

# Vitamin D Synthesis

The epidermal layer of human skin synthesizes Vitamin D when exposed to UV radiation. In the presence of sunlight, a form of Vitamin D<sub>3</sub> called cholecalciferol is synthesized from a derivative of the steroid cholesterol in the skin. The liver converts cholecalciferol to calcidiol, which is then converted to calcitriol (the active chemical form of the vitamin) in the kidneys.

- Vitamin D is essential for the normal absorption of calcium and phosphorus, which are required for healthy bones.
- The absence of sun exposure can lead to a lack of vitamin D in the body. In children, this can cause [rickets](#). Vitamin D deficiency in elderly individuals may lead to [osteomalacia](#).
- In present-day society, Vitamin D is added as a supplement to many foods, including milk and orange juice, compensating for the need for sun exposure. In addition to its essential role in bone health, Vitamin D is essential for general immunity against bacterial, viral, and fungal infections.

*Did you know?*

Vitamin D is essential for general immunity against bacterial, viral, and fungal infections.

Watch this video:

## The Integumentary System, Part 2 - Skin Deeper: Crash Course Anatomy & Physiol...



Media 5.2. [The Integumentary System, Part 2 – Skin Deeper: Crash Course A&P #7](#) [Online video]. Copyright 2015 by [CrashCourse](#).

## Accessory Structures

Accessory structures of the skin include hair, nails, sweat glands, and sebaceous glands. These structures embryologically originate from the epidermis and can extend down through the dermis into the [hypodermis](#).

## Hair

Hair is a keratinous filament growing out of the [epidermis](#). It is primarily made of dead, keratinized cells. Strands of hair originate in an epidermal penetration of the dermis called the hair follicle. The hair shaft is the part of the hair not anchored to the follicle, and much of this is exposed at the skin's surface. The rest of the hair, which is anchored in the follicle, lies below the surface of the skin and is referred to as

active basal cells called the hair matrix. The hair bulb surrounds the hair papilla, which is made of connective tissue and contains blood capillaries and nerve endings from the dermis (see [Figure 5.6](#)).

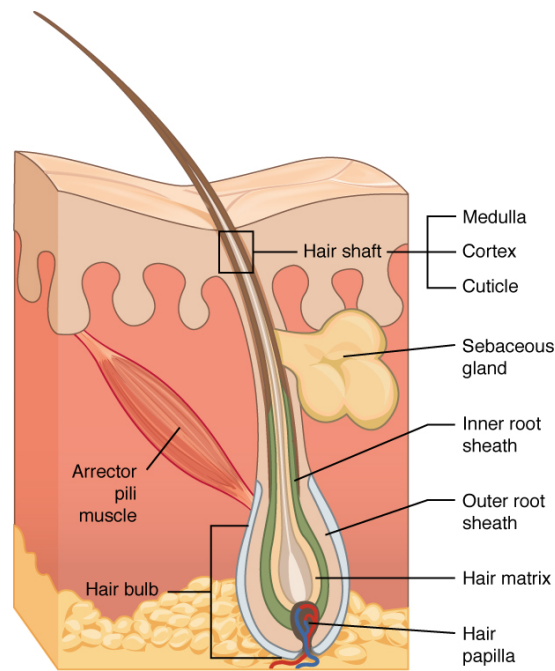


Figure 5.6 Hair. Hair follicles originate in the epidermis and have many different parts. From Betts et al., 2013. Licensed under [CC BY 4.0](#). [[Image description.](#)]

## Hair Function

Hair serves a variety of functions, including protection, sensory input, thermoregulation, and communication. For example:

- Hair on the head **protects** the skull from the sun.
- Hair in the nose and ears, and around the eyes (eyelashes) **defends** the body by trapping and excluding dust particles that may contain allergens and microbes.
- Hair of the eyebrows **prevents** sweat and other particles from dripping into and bothering the eyes.

Hair also has a **sensory function** due to sensory innervation by a hair root plexus surrounding the base of each hair follicle. Hair is extremely sensitive to air movement or other disturbances in the environment, much more so than the skin surface. This feature is also useful for the **detection** of the presence of insects or other potentially damaging substances on the skin surface.

Each hair root is connected to a smooth muscle called the arrector pili that contracts in response to nerve signals from the sympathetic nervous system, making the external hair shaft “stand up.” The primary purpose for this is to trap a layer of air to add insulation. This is visible in humans as goosebumps.

*Did you know?*

When frightened, the arrector pili muscle is responsible for your hair standing on end. The same is true when a cat's fur is raised.

### *Hair Growth, Loss, and Color*

Hair grows and is eventually shed and replaced by new hair. Hair typically grows at the rate of 0.3 mm per day. On average, 50 hairs are lost and replaced per day. Hair loss occurs if there is more hair shed than what is replaced and can happen due to hormonal or dietary changes. Hair loss can also result from the aging process, or the influence of hormones. Similar to the skin, hair gets its color from the pigment melanin, produced by [melanocytes](#) in the hair papilla. Different hair color results from differences in the type of melanin. As a person ages, the melanin production decreases, and hair tends to lose its color and becomes gray and/or white.

## Nails

The **nail bed** is a specialized structure of the epidermis that is found at the tips of our fingers and toes. The nail body is formed on the nail bed and protects the tips of our fingers and toes as they are the farthest extremities and the parts of the body that experience the maximum mechanical stress (see [Figure 5.7](#)). The nail body forms a back-support for picking up small objects with the fingers. The nail body is composed of densely packed dead [keratinocytes](#).

The epidermis in this part of the body has evolved a specialized structure upon which nails can form. The nail body forms at the nail root, which has a matrix of proliferating cells from the stratum basale that enables the nail to grow continuously. The lateral nail fold overlaps the nail on the sides, helping to anchor the nail body. The nail fold that meets the proximal end of the nail body forms the nail cuticle.



The nail bed is rich in blood vessels, making it appear pink, except at the base where a thick layer of epithelium over the nail matrix forms a crescent-shaped region called the **lunula** (the “little moon”). The area beneath the free edge of the nail, furthest from the cuticle, is called the hyponychium. It consists of a thickened layer of stratum corneum.

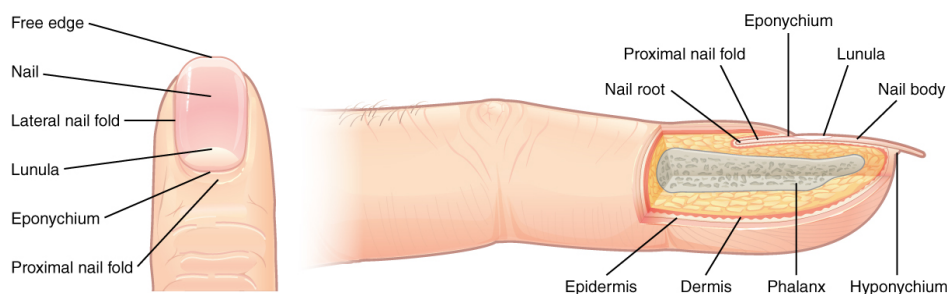


Figure 5.7 Nails. The nail is an accessory structure of the integumentary system. From Betts et al., 2013. Licensed under [CC BY 4.0](#). [[Image description](#).]

## Sweat Glands

### Sudoriferous Glands

When the body becomes warm, sudoriferous glands produce sweat to cool the body. Sweat glands develop from epidermal projections into the dermis and are classified as merocrine glands; that is, the secretions are secreted by [exocytosis](#) through a duct without affecting the cells of the gland. There are two types of sweat glands, each secreting slightly different products.

An **eccrine sweat gland** is a type of gland that produces hypotonic sweat for thermoregulation as described previously. These glands are found all over the skin's surface but are especially abundant on the palms of the hand, the soles of the feet, and the forehead ([Figure 5.8](#)). They are coiled glands lying deep in the dermis, with the duct rising up to a pore on the skin surface where the sweat is released. This type of sweat, released by [exocytosis](#), is hypotonic and composed mostly of water, with some salt, antibodies, traces of metabolic waste, and dermcidin, an antimicrobial peptide. **Eccrine glands** are a primary component of thermoregulation in humans and thus help to maintain [homeostasis](#).

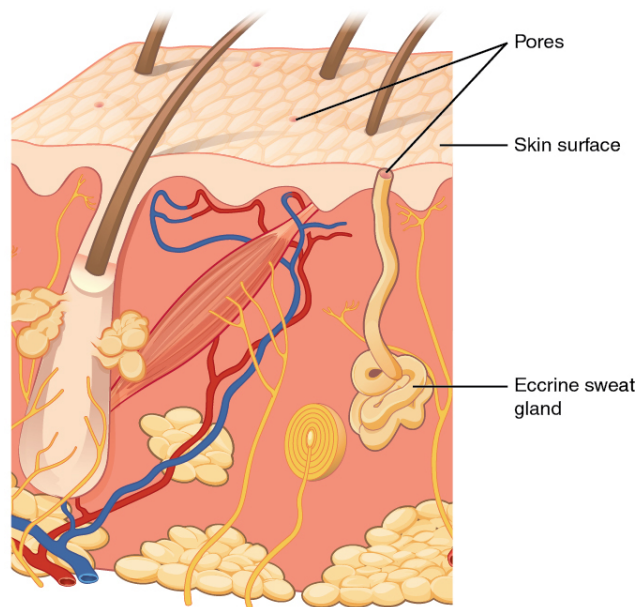


Figure 5.8 Eccrine Gland. Eccrine glands are coiled glands in the dermis that release sweat that is mostly water. From Betts et al., 2013. Licensed under [CC BY 4.0](#). [[Image description.](#)]

An **apocrine sweat gland** is usually associated with hair follicles in densely hairy areas, such as armpits and genital regions. Apocrine sweat glands are larger than eccrine sweat glands and lie deeper in the dermis, sometimes even reaching the hypodermis, with the duct normally emptying into the hair follicle. In addition to water and salts, apocrine sweat includes organic compounds that make the sweat thicker and subject to bacterial decomposition and subsequent smell. The release of this sweat is under both nervous and hormonal control and plays a role in the poorly understood human pheromone response. Most commercial antiperspirants use an aluminum-based compound as their primary active ingredient to stop sweat. When the antiperspirant enters the sweat gland duct, the aluminum-based compounds precipitate due to a change in [pH](#) and form a physical block in the duct, which prevents sweat from coming out of the pore.

## Sebaceous Glands

A **sebaceous gland** is a type of oil gland that is found all over the body and helps to lubricate and waterproof the skin and hair. Most sebaceous glands are associated with hair follicles. They generate and excrete sebum, a mixture of lipids, onto the skin surface, thereby naturally lubricating the dry and dead layer of keratinized cells of the stratum corneum, keeping it pliable. The fatty acids of sebum also have antibacterial properties and prevent water loss from the skin in low-humidity environments. The secretion of sebum is stimulated by hormones, many of which do not become active until puberty. Thus, sebaceous glands are relatively inactive during childhood.

*Did you know?*

Aluminum-based compounds due to a change in pH form a physical block in the sweat gland duct. This prevents sweating.

## Practice Terms Related to the Integumentary System



cellulitis

Turn

Card 1 of 42

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## Common Abbreviations for the Integumentary System

Many terms and phrases related to the integumentary system are abbreviated. Learn these common abbreviations by expanding the list below.

### Changes Due to Aging

All systems in the body accumulate subtle and some not-so-subtle changes as a person ages. Among these changes are reductions in cell division, metabolic activity, blood circulation, hormonal levels, and muscle strength (see [Figure 5.9](#)). In the skin, these changes are reflected in decreased mitosis in the stratum basale, leading to a thinner epidermis. The dermis, which is responsible for the elasticity and resilience of the skin, exhibits a reduced ability to regenerate, which leads to slower wound healing. The hypodermis, with its fat stores, loses structure due to the reduction and redistribution of fat, which in turn contributes to the thinning and sagging of skin.



*Figure 5.9 Aging. Generally, skin, especially on the face and hands, starts to display the first noticeable signs of aging, as it loses its elasticity over time. (credit: Janet Ramsden). From Betts et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)*

The accessory structures also have lowered activity, generating thinner hair and nails, and reduced amounts of sebum and sweat. A reduced sweating ability can cause some elderly to be intolerant to extreme heat. Other cells in the skin, such as [melanocytes](#) and dendritic cells, also become less active, leading to a paler skin tone and lowered immunity. Wrinkling of the skin occurs due to the breakdown of its structure, which results from decreased collagen and elastin production in the dermis, weakening of muscles lying under the skin, and the inability of the skin to retain adequate moisture.

*Did you know?*

A reduced sweating ability can cause some older adults to be intolerant to extreme heat.

## Diseases and Disorders of the Integumentary System

The integumentary system is susceptible to a variety of diseases, disorders, and injuries. These range from annoying but relatively benign bacterial or fungal infections that are categorized as disorders, to skin cancer and severe burns, which can be fatal. In this section, you will learn several of the most common skin conditions.

Most [cancers](#) are identified by the organ or tissue in which the cancer originates. In general, cancers result from an accumulation of DNA mutations. These mutations can result in cell populations that do not die when they should and uncontrolled cell proliferation that leads to tumors. Although many tumors are [benign](#), some [metastasize](#). Cancers are characterized by their ability to metastasize. One common form of cancer is skin cancer.

### Sun Damage

Melanin synthesis peaks about 10 days after initial sun exposure, which is why pale-skinned individuals tend to suffer sunburns of the epidermis initially. Dark-skinned individuals can also get sunburns but are more protected than are pale-skinned individuals. Too much sun exposure can eventually lead to wrinkling due to the destruction of the cellular structure of the skin, and in severe cases, can cause sufficient DNA damage to result in skin cancer. When there is an irregular accumulation of melanocytes in the skin, freckles appear. Moles are larger masses of melanocytes, and although most are benign, they should be monitored for changes that might indicate the presence of cancer (see [Figure 5.10](#)).



Figure 5.10 Moles. Moles range from benign accumulations of melanocytes to melanomas. These structures populate the landscape of our skin. (credit: the National Cancer Institute). From Betts et al., 2013. Licensed under [CC BY 4.0](#). [[Image description](#).]

## Basal Cell Carcinoma (BCC)

Basal cell carcinoma is a form of cancer that affects the mitotically active stem cells in the stratum basale of the epidermis. It is the most common of all cancers that occur in the United States and is frequently found on the head, neck, arms, and back, which are the most susceptible to long-term sun exposure. Although UV rays are the main culprit, exposure to other agents, such as radiation and arsenic, can also lead to this type of cancer. Wounds on the skin due to open sores, tattoos, burns, et cetera may be predisposing factors. Basal cell carcinomas start in the stratum basale and usually spread along this boundary. At some point, they begin to grow toward the surface and become an uneven patch, bump, growth, or scar on the skin surface (see [Figure 5.11](#)). Like most cancers, basal cell carcinomas respond best to treatment when caught early. Treatment options include surgery, freezing (cryosurgery), and topical ointments.

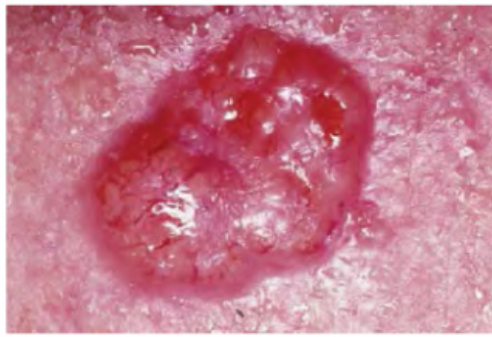


Figure 5.11 Basal Cell Carcinoma. Basal cell carcinoma can take several different forms. Similar to other forms of skin cancer, it is readily cured if caught early and treated. (credit: John Hendrix, MD). From Betts et al., 2013. Licensed under [CC BY 4.0](#). [[Image description.](#)]

## Squamous Cell Carcinoma (SCC)

Squamous cell carcinoma is cancer that affects the keratinocytes of the stratum spinosum and presents as lesions commonly found on the scalp, ears, and hands (see [Figure 5.12](#)). It is the second most common skin cancer. The American Cancer Society reports that two of 10 skin cancers are squamous cell carcinomas, and it is more aggressive than basal cell carcinoma. If not removed, these carcinomas can [metastasize](#). Surgery and radiation are used to cure squamous cell carcinoma.



Figure 5.12 Squamous Cell Carcinoma  
Squamous cell carcinoma presents here as a lesion on a nose. (credit: the National Cancer Institute). From Betts et al., 2013. Licensed under [CC BY 4.0](#). [[Image description.](#)]

Melanoma is cancer characterized by the uncontrolled growth of melanocytes, the pigment-producing cells in the epidermis. Typically, a melanoma develops from a mole. It is the most fatal of all skin cancers, as it is highly metastatic and can be difficult to detect before it has spread to other organs. Melanomas usually appear as asymmetrical brown and black patches with uneven borders and a raised surface (see [Figure 5.13](#)). Treatment typically involves surgical excision and immunotherapy.



Figure 5.13 Melanoma. Melanomas typically present as large brown or black patches with uneven borders and a raised surface. (credit: the National Cancer Institute). From Betts et al., 2013. Licensed under [CC BY 4.0](#). [[Image description](#).]

### *ABCDE for Early Diagnosis*

Doctors often give their patients the following ABCDE mnemonic to help with the diagnosis of early-stage melanoma. If you observe a mole on your body displaying these signs, consult a doctor:

- **A**symmetry: the two sides are not symmetrical
- **B**orders: the edges are irregular in shape
- **C**olor: the color is varied shades of brown or black
- **D**iameter: it is larger than 6 mm (0.24 in)
- **E**volving: its shape has changed

Some specialists cite the following additional signs for the most serious form, nodular melanoma:

- **E**levated: it is raised on the skin surface
- **F**irm: it feels hard to the touch



# Albinism

Albinism is a genetic disorder that affects (completely or partially) the coloring of skin, hair, and eyes. This is primarily due to the inability of melanocytes to produce melanin. Individuals with albinism tend to appear white or very pale due to the lack of melanin in their skin and hair. Recall that melanin helps protect the skin from the harmful effects of UV radiation. Individuals with albinism tend to need more protection from UV radiation, as they are more prone to sunburns and skin cancer. They also tend to be more sensitive to light and have vision problems due to the lack of pigmentation on the retinal wall.

Treatment of this disorder usually involves addressing the symptoms, such as limiting UV light exposure to the skin and eyes. In **vitiligo**, the melanocytes in certain areas lose their ability to produce melanin, possibly due to an autoimmune reaction. This leads to a loss of color in patches (see [Figure 5.14](#)). Neither albinism nor vitiligo directly affects the lifespan of an individual.



*Figure 5.14 Vitiligo. Individuals with vitiligo experience depigmentation that results in lighter colored patches of skin. The condition is especially noticeable on darker skin. (credit: Klaus D. Peter). From Betts et al., 2013. Licensed under [CC BY 4.0](#). [[Image description.](#)]*

## Changes in Skin Coloration

Other changes in the appearance of skin coloration can be indicative of diseases associated with other body systems.

- Tumors of the pituitary gland can result in the secretion of large amounts of melanocyte-stimulating hormone (MSH), which results in a **darkening** of the skin.
- Addison's disease can stimulate the release of excess amounts of adrenocorticotrophic hormone (ACTH), which can give the skin a **deep bronze** color
- A sudden drop in oxygenation can affect skin color, causing the skin to initially turn **ashen** (white).
- After a prolonged reduction in oxygen levels, dark red deoxyhemoglobin becomes dominant in the blood, making the skin appear **blue**, a condition referred to as [cyanosis](#). This happens when the oxygen supply is restricted, as when someone is experiencing difficulty in breathing because of asthma or a heart attack. However, in these cases, the effect on skin color has nothing to do with the skin's pigmentation.

## Skin Disorders

Two common skin disorders are **eczema** and **acne**. Eczema is an inflammatory condition and occurs in individuals of all ages. Acne involves the clogging of pores, which can lead to infection and inflammation and is often seen in adolescents. Other disorders include seborrheic dermatitis (on the scalp), psoriasis, fungal infections, cold sores, impetigo, scabies, hives, and warts.

### Eczema

Eczema is an allergic reaction that manifests as dry, itchy patches of skin that resemble rashes (see [Figure 5.15](#)). It may be accompanied by swelling of the skin, flaking, and in severe cases, bleeding. Symptoms are usually managed with moisturizers, corticosteroid creams, and immunosuppressants.



*Figure 5.15 Eczema. Eczema is a common skin disorder that presents as a red, flaky rash. (credit: "Jambula"/Wikimedia Commons). From Betts et al., 2013. Licensed under [CC BY 4.0](#). [\[Image\]](#)*

# Acne

Acne is a skin disturbance that typically occurs on areas of the skin that are rich in sebaceous glands (face and back). It is most common along with the onset of puberty due to associated hormonal changes, but can also occur in infants and continue into adulthood. Hormones, such as androgens, stimulate the release of sebum. Overproduction and accumulation of sebum along with keratin can block hair follicles. This plug is initially white. The sebum, when oxidized by exposure to air, turns black. Acne results from infection by acne-causing bacteria (*Propionibacterium* and *Staphylococcus*), which can lead to redness and potential scarring due to the natural wound healing process (see [Figure 5.16](#)).

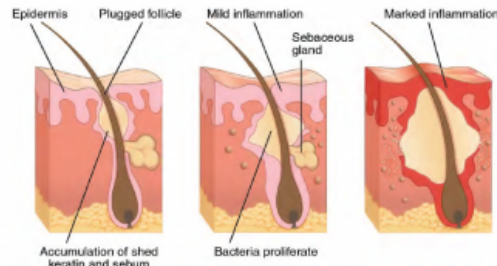


Figure 5.16. Acne. Acne is a result of over-productive sebaceous glands, which leads to the formation of blackheads and inflammation of the skin. From Betts et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

# Ringworm

Tinea or dermatophytosis is often referred to as ringworm. Ringworm presents as a circular rash that is itchy and red and can be found on various parts of the body. It is referred to by the location that it is found:

- Tinea pedis – feet (commonly referred to as athlete’s feet)
- Tinea capitis – scalp
- Tinea barbae – beard
- Tinea manuum – hands
- Tinea unguium – toenails and fingernails (also called onychomycosis)
- Tinea corporis – body parts such as arms and legs (Center for Disease Control and Prevention, n.d.-a)

To learn more about ringworm, visit the [Center for Disease Control and Prevention’s web page on fungal infections](#)

# Psoriasis

Psoriasis is a chronic autoimmune disorder that results in patches of thick red skin with the appearance of silvery scales. These patches can be found on elbows, knees, scalp, low back, face, feet, fingernails, toenails, and even the mouth. Psoriasis can be confused with other skin diseases, so a dermatologist is the best physician to diagnose psoriasis. Treatments may include creams, ointments, ultraviolet light therapy, and medication (Center for Disease Control and Prevention, n.d.-b). To learn more, visit the [Center for Disease Control and Prevention's web page on psoriasis](#).

# Injuries

Because the skin is the part of our bodies that meets the world most directly, it is especially vulnerable to injury. Injuries include **burns, wounds, scars, and calluses**. They can be caused by sharp objects, heat, or excessive pressure or friction to the skin.

Skin injuries set off a healing process that occurs in several overlapping stages.

- The first step to repairing damaged skin is the **formation of a blood clot** that helps stop the flow of blood and scabs over time. Many different types of cells are involved in wound repair, especially if the surface area that needs repair is extensive.
- Before the basal stem cells of the stratum basale can recreate the epidermis, fibroblasts mobilize and divide rapidly to **repair the damaged tissue** by collagen deposition, forming granulation tissue.
- Blood capillaries follow the fibroblasts and help **increase blood circulation and oxygen** supply to the area.
- Immune cells, such as macrophages, roam the area and **engulf any foreign matter** to reduce the chance of infection.

# Burns

A burn results when the skin is damaged by intense heat, radiation, electricity, or chemicals. The damage results in the death of skin cells, which can lead to a massive loss of fluid. Dehydration, electrolyte imbalance, and renal and circulatory failure follow, which can be fatal. Burn patients are treated with [intra-venous](#) fluids to offset [dehydration](#), as well as intravenous nutrients that enable the body to repair tissues and replace lost proteins. Another serious threat to the lives of burn patients is [infection](#). Burned

## Burn Classification

Burns are sometimes measured in terms of the size of the total surface area affected. This is referred to as the *rule of nines*, which associates specific anatomical areas with a percentage that is a factor of nine (see [Figure 5.17](#)).

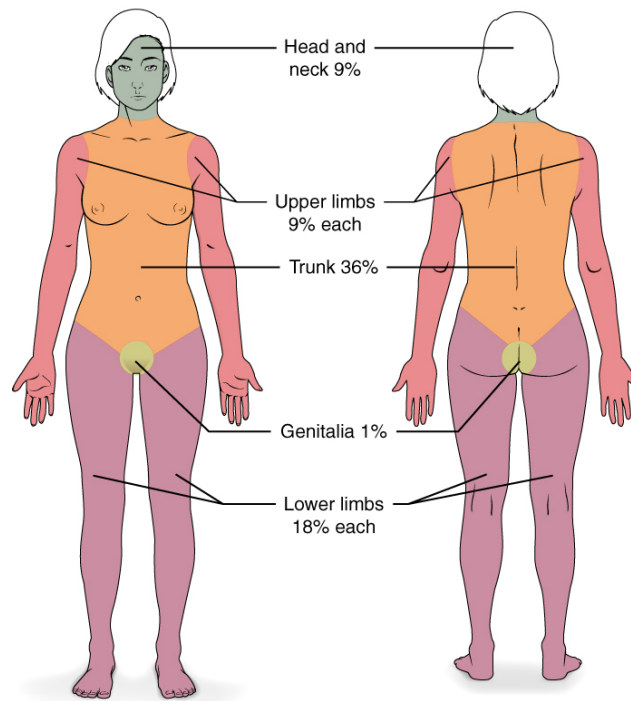


Figure 5.17 Calculating the Size of a Burn. The size of a burn will guide decisions made about the need for specialized treatment. Specific parts of the body are associated with a percentage of body area. From Betts et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Burns are also classified by the degree of their severity:

- A **first-degree** burn is a superficial burn that affects only the epidermis. Although the skin may be painful and swollen, these burns typically heal on their own within a few days. Mild sunburn fits into the category of a first-degree burn.
- A **second-degree** burn goes deeper and affects both the epidermis and a portion of the dermis. These burns result in swelling and a painful blistering of the skin. It is important to keep the burn site clean and sterile to prevent infection. If this is done, the burn will heal within several weeks.
- A **third-degree** burn fully extends into the epidermis and dermis, destroying the tissue and affecting the nerve endings and sensory function. These are serious burns that may appear white, red, or black; they require medical attention and will heal slowly without it.

are damaged. Full-thickness burns cannot be repaired by the body, because the local tissues used for repair are damaged and require [debridement](#), or amputation in severe cases, followed by grafting of the skin from an unaffected part of the body, or from skin grown in tissue culture for grafting purposes. Skin grafts are required when the damage from trauma or infection cannot be closed with sutures or staples.

## Scars and Keloids

Most cuts or wounds, with the exception of ones that only scratch the epidermis, lead to [scar](#) formation. Scarring occurs in cases in which there is repair of skin damage, but the skin fails to regenerate the original skin structure. Fibroblasts generate scar tissue in the form of collagen, and the bulk of repair is due to the basket-weave pattern generated by collagen fibers and does not result in regeneration of the typical cellular structure of skin. Instead, the tissue is fibrous in nature and does not allow for the regeneration of accessory structures, such as hair follicles, sweat glands, or sebaceous glands.

Sometimes, there is an overproduction of scar tissue, because the process of collagen formation does not stop when the wound is healed; this results in a [keloid](#). In contrast, scars that result from acne and chickenpox have a sunken appearance and are called atrophic scars.

Scarring of skin after wound healing is a natural process and does not need to be treated further. Application of mineral oil and lotions may reduce the formation of scar tissue. However, modern cosmetic procedures, such as dermabrasion, laser treatments, and filler injections have been invented as remedies for severe scarring. All of these procedures try to reorganize the structure of the epidermis and underlying collagen tissue to make it look more natural.

## Bedsores and Stretch Marks

Skin and its underlying tissue can be affected by excessive pressure. One example of this is called a bed-sore. Bedsores, also called **decubitus ulcers**, are caused by constant, long-term, unrelieved pressure on certain body parts that are bony, reducing blood flow to the area and leading to [necrosis](#). Bedsores are most common in elderly patients who have debilitating conditions that cause them to be immobile. Most hospitals and long-term care facilities have the practice of turning the patients every few hours to prevent the incidence of bedsores. If left untreated, bedsores can be fatal if they become infected.

The skin can also be affected by pressure associated with rapid growth. A stretch mark results when the dermis is stretched beyond its limits of elasticity, as the skin stretches to accommodate the excess pressure. Stretch marks usually accompany rapid weight gain during puberty and pregnancy. They initially

# Calluses

When you wear shoes that do not fit well and are a constant source of abrasion on your toes, you tend to form a callus at the point of contact. This occurs because the basal stem cells in the stratum basale are triggered to divide more often to increase the thickness of the skin at the point of abrasion to protect the rest of the body from further damage. This is an example of a minor or local injury, and the skin manages to react and treat the problem independently of the rest of the body. Calluses can also form on your fingers if they are subject to constant mechanical stress, such as long periods of writing, playing string instruments, or video games. A corn is a specialized form of callus. Corns form from abrasions on the skin that result from an elliptical-type motion.

## Medical Terms in Context

**Drag the words into the correct boxes.**

INTEGUMENTARY SYSTEM – CONSULTATION REPORT

PATIENT NAME: Rosemary COOMBS

AGE: 54

Sex: Female

DOB: December 2

DATE OF CONSULTATION: May 29

REQUESTING PHYSICIAN: Trevor Sharpe, MD, Family Medicine

CONSULTING PHYSICIAN: Donna Brown, MD, Dermatology

excisional

benign

biopsy

asymmetrical

lesion

mole

irregular

HISTORY: This 54-year-old white female, went to her family doctor a year ago when she noticed a dark brown spot on her neck. The spot was a six cm, dark brown, flat \_\_\_\_\_ with smooth borders that appeared \_\_\_\_\_. Ms. Coombs recently went to Dr. Sharpe for a physical and the \_\_\_\_\_ was examined, it was suggested that Ms. Coombs see me.

PAST HISTORY: No known history of any skin disorders.

PHYSICAL EXAMINATION: Normal except for the lesion on her chest which has grown to 1.3 cm in diameter and \_\_\_\_\_ in shape. It is mainly dark brown, with regions of darker black. The borders are \_\_\_\_\_ in outline. There is some blackened areas that are slightly elevated.

PLAN: I have booked a follow up appointment for next week to do an \_\_\_\_\_ biopsy. I will then send the specimen for a \_\_\_\_\_. Another follow up appointment will be made once I receive the results of the biopsy.

---

Donna Brown, MD, Dermatology

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Drag the words into the correct boxes. Remember combining form vowels are indicated with a line on each side.

\_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ refers to the surgical repair of one's own skin.  
Something that generates the production of epidermal tissues might be called \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ .  
\_\_\_\_\_ / \_\_\_\_\_ refers to something in a state of death.  
\_\_\_\_\_ / \_\_\_\_\_ is a technical name for finger-biting.  
\_\_\_\_\_ / \_\_\_\_\_ means pertaining to through the skin.  
\_\_\_\_\_ / \_\_\_\_\_ injection is given under the skin.

during the winter months many people complain of \_\_\_\_\_ / \_\_\_\_\_ and use extra lotion.

A patch filled with medication, applied to the skin so that medication goes through the skin is referred to as a \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ patch.

An instrument used to cut the skin for biopsy is referred to as a \_\_\_\_\_ / \_\_\_\_\_ .

A specialist who studies and treats disorders and diseases of the skin is referred to as a \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ .

The medical term that means a sweat gland is inflamed is \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ .

The medical term to excise wrinkles or commonly referred to as a facelift is \_\_\_\_\_ / \_\_\_\_\_ .

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# Medical Specialties and Procedures Related to the Integumentary System

A dermatologist is a medical doctor with specialized training in treating diseases, disorders, and injuries related to the integumentary system and its accessory structures. There are many dermatologic subspecialties, such as cosmetic dermatology, dermatopathology, and pediatric dermatology. To learn more, visit the [American Academy of Dermatology Association's webpage on dermatology as a career](#).

Dermatologists can be specially trained to perform a procedure called Mohs surgery. Mohs surgery excises skin cancers in thin layers until all cancer is removed from the tissue (Prickett & Ramsey, 2021).

## Integumentary System Vocabulary

### **Abscess**

An enclosed collection of pus in tissues, organs, or confined spaces in the body.

### **Adipocyte**

Fat cell.

### **Adipose tissue**

Fat tissue.

### **Autonomic**

Involuntary or unconscious.

### **Avascular**

Without blood vessels.

### **Bacteria**

Single-cell microorganisms that reproduce by cell division and may cause infection by invading body

Non-cancerous.

## **Biopsy**

The removal of cells or tissues for examination by a pathologist.

## **Cancer**

Abnormal cells in the body that divide uncontrollably.

## **Cauterize**

To destroy tissue using a hot or cold instrument, an electrical current, or a chemical that burns or dissolves the tissue to kill tumors or stop bleeding.

## **Cellulitis**

An infection of the skin and subcutaneous tissue, characterized by tenderness, fever, and blisters.

## **Contusion**

Injury resulting in a bruise.

## **Cyanosis**

A condition in which the oxygen supply is restricted, causing the skin to look blue.

## **Cyst**

Closed sac containing fluid or semisolid material.

## **Debridement**

Excision of damaged tissues and cell debris from a wound or burn to prevent infection and promote healing.

## **Dehydration**

A net loss of water that results in insufficient water in blood and other tissues.

## **Dermabrasion**

A procedure to remove superficial scars using sandpaper or revolving wire brushes.

## **Dermatitis**

Fibrous tumor of the skin.

## **Dermatologist**

Medical doctor who specializes in diagnosing and treating skin disorders.

## **Dermatology**

Study of disorders of the skin.

## **Dermis**

The layer of skin that is made of dense, irregular connective tissue that houses blood vessels, hair follicles, sweat glands, and other structures.

## **Diaphoresis**

Sweating.

## **Eczema**

Non-infectious, inflammatory disease presenting as redness, blisters, scabs, and itching.

## **Edema**

Swelling due to excessive liquid in the tissues.

## **Epidermis**

The outer, protective layer of the skin.

## **Excisional skin surgery**

A surgical procedure used to remove moles, cysts, skin cancer, and other skin growths using local anesthesia.

## **Exocytosis**

A form of active transport in which a cell exports material using vesicular transport.

## **Fascia**

Fibrous tissue.

## **Frostbite**

Death of tissue due to blood supply loss.

### **Hidradenitis**

Inflammation of a sweat gland.

### **Hypodermis**

Also known as the subcutaneous layer; the layer of the skin below the dermis that is composed mainly of loose connective and fatty tissues.

### **Incision**

A cut made in the body to perform surgery.

### **Infection**

The invasion and growth of bacteria, viruses, yeast, fungi, or other microorganisms in the body.

### **Intradermal**

Within the skin.

### **Intravenous**

Into or within the vein.

### **Jaundiced**

Yellow-colored.

### **Keloid**

A raised or hypertrophic scar.

### **Keratinocytes**

Cells that manufacture and store the protein keratin.

### **Keratinosis**

Any growth of horny tissue.

### **Laceration**

Torn, ragged-edged wound.

An area of abnormal tissue.

### **Meissner corpuscle**

A specialized sensory nerve structure that responds to light touch.

### **Melanocyte**

A cell that produces the pigment melanin.

### **Metastasis**

The process in which cancer spreads from one part of the body to another.

### **Necrosis**

Accidental cell death.

### **Nevus**

A benign growth on the skin that is formed by a cluster of melanocytes.

### **Nodule**

A growth or lump that may be malignant or benign.

### **Onychocryptosis**

An ingrown nail.

### **Onychomycosis**

A fungal infection of the nail.

### **Onychophagia**

Nail-biting.

### **Osteomalacia**

A softening of adult bones due to Vitamin D deficiency.

### **Pacinian corpuscle**

A specialized sensory nerve structure that responds to vibration.

### **Pallor**

## **Paronychia**

Infection of the skin around the nail.

## **Pathogen**

An organism that causes a disease.

## **Percutaneous**

Passing through the skin, as an injection or a topical medicine.

## **Phagocytes**

Cells that engulf and absorb bacteria and cell particles.

## **Pruritus**

Itching.

## **Reticulated**

Net like.

## **Rhytidoplasty**

Excision of wrinkles of the skin.

## **Rickets**

A painful condition in children where bones are misshapen due to a lack of calcium, causing bow-leggedness.

## **Scar**

A collagen-rich skin formed after the process of wound healing that differs from normal skin.

## **Staphylococcus aureus**

A bacteria that is commonly found in minor skin infections, as well as in the nose of some healthy people.

## **Stratum basale**

The deepest layer of the epidermis.

## Subcutaneous

Beneath the skin.

## Sympathetic nervous system

The division of the nervous system involved in our fight-or-flight responses. It continuously monitors body temperature and initiates appropriate motor responses.

## Tinea

A group of fungal skin diseases of the hair, skin, and nail tissues.

## Transdermal

Absorbed through the unbroken skin.

## Vascularized

Tissue that has numerous blood vessels.

## Virus

A simple microorganism that may cause infection by invading body tissue.

## Test Yourself

Cells that manufacture and store the protein keratin...



Keratinocytes

Vascularized

Scar

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## Image Descriptions

**Figure 5.1 image description:** This illustration shows a cross-section of skin tissue. The outermost layer is called the epidermis and occupies one-fifth of the cross-section. Several hairs are emerging from the surface. The epidermis dives around one of the hairs, forming a follicle. The middle layer is called the dermis, which occupies four-fifths of the cross-section. The dermis contains an arrector pili muscle connected to one of the follicles. The dermis also contains an eccrine sweat gland, composed of a bunch of tubules. One tubule travels up from the bunch, through the epidermis, opening onto the surface of a pore. There are two string-like nerves traveling vertically through the dermis. The right nerve is attached to a Pacinian corpuscle, which is a yellow structure consisting of concentric ovals similar to an onion. The lowest level of the skin, the hypodermis, contains fatty tissue, arteries, and veins. Blood vessels travel from the hypodermis and connect to hair follicles and arrector pili muscle in the dermis. [\[Return to Figure 5.1\]](#).

**Figure 5.2 image description:** Part A is a micrograph showing a cross-section of thin skin. The topmost layer is a thin, translucent layer with irregular texture and areas where cells are sloughing off. The deepest layer is dark purple and extends into the third layer with finger-like projections. The third light purple layer contains thin bands of fibers and small, dark cells. The fourth, and deepest layer, is darker than the third layer but is still light purple. It contains thick fiber bands that are loosely packed. Part B is a magnified view of the epidermis of thick skin. It shows the topmost layer is five times thicker than the topmost layer of thin skin. The topmost layer of thick skin is also denser and less translucent than the topmost layer of thin skin. [\[Return to Figure 5.2\]](#).

**Figure 5.3 image description:** The outer layer of cells in this micrograph is the thinnest layer and stained deep purple due to the full keratinization of dead cells. The next layer occupies one-quarter of

layer is densely-packed, with thick bands of highly organized muscle tissue that are darkly stained. [\[Return to Figure 5.3\].](#)

**Figure 5.4 image description:** This micrograph shows layers of skin in a cross-section. The papillary layer of the dermis extends between the downward fingers of the darkly stained epidermis. The papillary layer appears finer than the reticular layer, consisting of smaller, densely-packed fibers. The reticular layer is three times thicker than the papillary layer and contains larger, thicker fibers. The fibers seem more loosely packed than those of the papillary layer, with some separated by empty spaces. Both layers of the dermis contain cells with darkly stained nuclei. [\[Return to Figure 5.4\].](#)

**Figure 5.5 image description:** Part A is a photo of a man skiing with several snow-covered trees in the background. Part B is a diagram with a right and left half. The left half is titled “Heat is retained by the body,” while the right half is titled “Heat loss through radiation and convection.” Both show blood flowing from an artery through three capillary beds within the skin. The beds are arranged vertically, with the topmost bed located along the boundary of the dermis and epidermis. The bottommost bed is located deep in the hypodermis. The middle bed is evenly spaced between the topmost and bottommost beds. In each bed, oxygenated blood (red) enters the bed on the left and deoxygenated blood (blue) leaves the bed on the right. The left diagram shows a picture of snowflakes above the capillary beds, indicating that the weather is cold. Blood is only flowing through the deepest of the three capillary beds, as the upper beds are closed off to reduce heat loss from the outer layers of the skin. The right diagram shows a picture of the sun above the capillary beds, indicating that the weather is hot. Blood is flowing through all three capillary beds, allowing heat to radiate out of the blood, increasing heat loss. Part C is a photo of a man running through a forested trail on a summer day. [\[Return to Figure 5.5\].](#)

**Figure 5.6 image description:** A cross-section of the skin containing a hair follicle. The follicle is teardrop-shaped. Its enlarged base, labeled the hair bulb, is embedded in the hypodermis. The outermost layer of the follicle is the epidermis, which invaginates from the skin surface to envelop the follicle. Within the epidermis is the outer root sheath, which is only present on the hair bulb. It does not extend up the shaft of the hair. Within the outer root sheath is the inner root sheath. The inner root sheath extends about half of the way up the hair shaft, ending midway through the dermis. The hair matrix is the innermost layer. The hair matrix surrounds the bottom of the hair shaft where it is embedded within the hair bulb. The hair shaft, in itself, contains three layers: the outermost cuticle, a middle layer called the cortex, and an innermost layer called the medulla. [\[Return to Figure 5.6\].](#)

**Figure 5.7 image description:** The anatomy of the fingernail region. The top image shows a dorsal view of a finger. The proximal nail fold is the part underneath where the skin of the finger connects with the edge of the nail. The eponychium is a thin, pink layer between the white proximal edge of the nail (the lunula), and the edge of the finger skin. The lunula appears as a crescent-shaped white area at the proximal edge of the pink-shaded nail. The lateral nail folds are where the sides of the nail contact the finger skin. The distal edge of the nail is white and is called the free edge. An arrow indicates that the nail

**Figure 5.8 image description:** An illustration of an eccrine sweat gland embedded in a cross-section of skin tissue. The eccrine sweat gland is a bundle of white tubes embedded in the dermis. A single white tube travels up from the bundle and opens onto the surface of the epidermis. The opening is called a pore. There are several pores on the small block of skin portrayed in this diagram. [\[Return to Figure 5.8\]](#).

**Figure 5.9 image description:** This figure consists of two photos. One photo shows a young woman on the phone. Her skin is smooth and unwrinkled. The other photo shows an elderly woman in the same posture while on the phone. The skin of her hands and forearms is wrinkled. [\[Return to Figure 5.9\]](#).

**Figure 5.10 image description:** Five photos of moles. The three upper photos show moles that are small, flat, and dark brown. The bottom left photo shows a dark black mole that is raised above the skin. The bottom right photo shows a large, raised, reddish mole with protruding hairs. [\[Return to Figure 5.10\]](#).

**Figure 5.11 image description:** This photo shows an enlarged view of a basal cell carcinoma, a large, pink, irregular bump on the skin. The carcinoma is marked with irregular, dark-red stripes that resemble tiny blood vessels. The surrounding skin is the same pink color as the carcinoma, but without the red striping or raised appearance. [\[Return to Figure 5.11\]](#).

**Figure 5.12 image description:** This photo shows a man's nose. The squamous cell carcinoma is located just above the tip of the nose and appears as a deep red, irregularly-shaped sore that spans almost the entire bridge of his nose. [\[Return to Figure 5.12\]](#).

**Figure 5.13 image description:** This photo shows a patch of fair skin containing a large melanoma. The melanoma is dark brown and splotchy in appearance. [\[Return to Figure 5.13\]](#).

**Figure 5.14 image description:** This photo shows the back of a man's neck. There is a large, discolored patch of skin at the base of his hairline. The discolored area extends over the ears onto the cheeks, toward the front of the face. The man's head and facial hair are mostly gray, but white patches of hair are seen above the discolored skin. [\[Return to Figure 5.14\]](#).

**Figure 5.15 image description:** This photo shows a person with eczema on the ventral skin of the forearms. The person is white, but their light skin is mottled with many red marks, giving it the appearance of a rash. In some areas, the skin is breaking and peeling. [\[Return to Figure 5.15\]](#).

**Figure 5.16 image description:** Three diagrams show the progression of acne in three steps from left to right. All three depict a cross-section of skin containing a hair follicle. In the left diagram, the follicle has a swollen area about halfway up the hair shaft, just above a sebaceous gland. The follicle is plugged with sebum, depicted as a yellowish substance. In the middle diagram, the follicle has become more swollen, as a label indicates that bacteria are reproducing within the blockage. The surrounding epidermis becomes inflamed as a result of the bacterial infection. In the rightmost image, the blockage has swollen to about five times its original size and has broken the surrounding epidermis, which is now red and inflamed. [\[Return to Figure 5.16\]](#).

a victim suffers complete burns to regions of the body. Complete burning of the face, head, and neck account for 19% of the total body area. Burning of the chest, abdomen, and entire back above the waist accounts for 36% of the total body area. Anterior and posterior surfaces of the arms and hands account for 18% of the total body area (9% for each arm). The anterior and posterior surface of both legs, along with the buttocks, accounts for 36% of the total body area (18% for each leg). Finally, the anterior and posterior surfaces of the genitalia account for 1% of the total body area. [[Return to Figure 5.17](#)].

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