

# CHAPTER 3: INTEGUMENTARY SYSTEM

*Building a Medical Terminology Foundation 2e* by Kimberlee Carter; Marie Rutherford; and Connie Stevens

- 3.1 – Introduction to the Integumentary System
- 3.2 – Anatomy (Structures) of the Integumentary System
- 3.3 – Physiology (Function) of the Integumentary System
- 3.4 – Accessory Structures
- 3.5 – Integumentary System Changes (Aging, Disease and Disorders, Skin)
- Vocabulary & Check Your Knowledge
- References

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## 3.1 - Introduction to the Integumentary System

### Learning Objectives

- Identify the anatomy and describe the main functions of the integumentary system and accessory structures
- Analyze, translate, and define medical terms and common abbreviations of the integumentary system
- Practice the spelling and pronunciation of integumentary system medical terminology
- Identify the medical specialties associated with the integumentary system and explore common diseases, disorders, diagnostic tests and procedures

### Integumentary System Word Parts

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

#### Prefix

- **a-** (absence of, without)
- **bi-** (two or both)
- **dia-** (through, complete)
- **dys-** (difficult, painful, abnormal, laboured)
- **epi-** (upon, on, over)
- **hyper-** (above, excessive)
- **hypo-** (deficient, below, under, incomplete)
- **intra-** (within, in)
- **meta-** (change, beyond, after)
- **neo-** (new)

- **para-** (beside, around, beyond, abnormal)
- **per-** (through)
- **pro-** (before)
- **sub-** (under, below)
- **trans-** (through, across, beyond)
- **uni-** (one)

### Combining Form

- **aut/o** (self)
- **bi/o** (life)
- **coni/o** (dust)
- **crypt/o** (hidden)
- **cutane/o** (skin)
- **derm/o** (skin)
- **dermat/o** (skin)
- **heter/o** (other)
- **hidr/o** (sweat)
- **kerat/o** (hard, horny tissue, keratin)
- **lei/o** (smooth)
- **myc/o** (fungus)
- **necr/o** (death)
- **onych/o** (nail)
- **pachy/o** (thick)
- **rhytid/o** (wrinkles)
- **seb/o** (sebum)
- **staphyl/o** (grapelike clusters)
- **strept/o** (twisted chains)
- **ungu/o** (nail)
- **xer/o** (dryness, dry)

### Suffix

- **-a** (no meaning, noun ending)
- **-al** (pertaining to)
- **-ad** (toward)
- **-coccus** (berry-shaped)
- **-cyte** (cell)
- **-ectomy** (excision)
- **-gen** (substance that produces/causes, agent that produces/causes)
- **-genic** (producing, originating, causing)
- **-ia** (condition of, diseased state, abnormal state)
- **-ic** (pertaining to)
- **-itis** (inflammation)

- **-ior** (pertaining to)
- **-logy** (study of)
- **-logist** (specialist who studies and treats)
- **-malacia** (softening)
- **-megaly** (enlarged, enlargement)
- **-oid** (resembling)
- **-oma** (tumour, swelling)
- **-opsy** (view of, process of viewing, viewing)
- **-osis** (abnormal condition, increased numbers relating to blood)
- **-ous** (pertaining to)
- **-pathy** (disease)
- **-phagia** (eating, swallowing)
- **-plasia** (development, growth, condition of formation)
- **-plasm** (growth, substance, formation)
- **-plasty** (surgical repair)
- **-rrhea** (flow, discharge)
- **-sis** (state of)
- **-stasis** (stop, controlling, standing)
- **-tome** (instrument used to cut)

**Activity source:** Integumentary System Word List by Jesslyn Wilkinson, licensed under CC BY 4.0./  
Converted to text.

## 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 percent 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 The Integumentary System, Part 1 – Skin Deep: Crash Course Anatomy & Physiology #6 (10 min) on YouTube (<https://youtu.be/Orumw-PyNjw>)

## Integumentary Medical Terms

Practice the following Integumentary System words by breaking into word parts and pronouncing  
**Integumentary Medical Terms (Text version)**

1. **biopsy (bx)**

- BĪ-op-sē
- view of life (removal of living tissue to be viewed under a microscope)

2. **dermatitis**

- dĕr-mă-TĪT-ĭs
- inflammation of the skin

3. **dermatoautoplasty**

- dĕr-mă-tō-AW-tō-plăs-tē
- surgical repair using one's own skin

4. **dermatosis**

- dĕr-mă-tō-kō-nē-Ō-sĭs
- abnormal condition of the skin caused by dust

5. **dermatofibroma**

- dĕr-mă-tō-fi-BRŌ-mă
- fibrous tumour of the skin

6. **dermatoheteroplasty**

- dĕr-mă-tō-HĒT-ĕr-ō-plăs-tē

- surgical repair using skin from others
7. **dermatologist**
    - dĕr-mă-TŌL-ō-jĭst
    - Physician who specializes in treating diseases and disorders of the skin
  8. **dermatology (derm)**
    - dĕr-mă-TŌL-ō-jĕ
    - study of the skin
  9. **dermatome**
    - DĚR-mă-tōm
    - instrument used to cut skin
  10. **dermatoplasty**
    - DĚR-măt-ō-plas-tĕ
    - get meaning
  11. **epidermal**
    - ěp-ĭ-DĚR-mal
    - pertaining to upon/on the skin
  12. **erythroderma**
    - ě-rith-rŏ-DĚR-mă
    - red skin
  13. **hidradenitis**
    - hi-dra-ĕn-ĪT-ĭs
    - inflammation of a sweat gland
  14. **hypodermic**
    - hĭ-pŏ-DĚR-mĭk
    - pertaining to below the skin
  15. **intra dermal (ID)**
    - in-tră-DĚR-măl
    - pertaining to within the skin
  16. **keratogenic**
    - kĕr-ă-TŌJ-ĕ-nŭk
    - agent that causes growth of horny tissue

17. **keratosis**

- ker-ă-TŌ-sīs
- abnormal condition of growth of horny tissue

18. **leioderma**

- lī-ō-DĚR-mē-ă
- condition of smooth skin

19. **leukoderma**

- loo-kŏ-DĚR-mă
- white patches caused by depigmentation

20. **necrosis**

- ně-KRŌ-sīs
- condition of death

21. **onychocryptosis**

- ōn-ĭ-kŏ-krip-TŌ-sīs
- abnormal condition of a hidden nail

22. **onychomalacia**

- ōn-ĭ-kŏ-mă-LĀ-shă
- softening of the nails

23. **onychomycosis**

- on-i-kŏ-mī-KŌ-sīs
- abnormal condition of a fungus in the nails

24. **onychophagia**

- ōn-ĭ-KŌF-ă-jĕ
- eating the nails (nail biting)

25. **pachyderma**

- pak-ē-DĚR-mă
- thickening of the skin

26. **paronychia**

- păr-ō-NĪK-ē-ă
- diseased state around the nail

27. **percutaneous**

- pĕr-kū-TĀ-nē-ŭs
  - pertaining to through the skin
28. **rhytidectomy**
- rit-ĭ-DEK-tō-mē
  - excision of the wrinkles
29. **rhytidoplasty**
- RĪT-ĭ-dō-plās-tē
  - surgical repair of wrinkles
30. **seborrhea**
- sĕb-or-Ē-ă
  - discharge (excessive) of sebum
31. **staphylococcus (staph)**
- staf-ĭ-lō-KOK-ŭs
  - berry-shaped bacterium in grape-like clusters
32. **streptococcus (strep)**
- strep-tō-KOK-ŭs
  - berry-shaped bacterium in twisted chains
33. **subcutaneous (subcut, Sub-Q)**
- sŭb-kū-TĀ-nē-ŭs
  - pertaining to under the skin
34. **subungual**
- sŭb-ŪNG-gwāl
  - pertaining to under the nail
35. **transdermal (TD)**
- trānz-DĚRM-ăl
  - pertaining to through the skin
36. **ungual**
- ŪNG-gwāl
  - pertaining to the nail
37. **xeroderma**
- zer-ō-DĚR-mă



- dry skin

38. **xerosis**

- zĕ-RŌ-sĭs
- abnormal condition of dryness

**Activity source:** Integumentary Medical Terms from *Medical Terminology* by Grimm et al., licensed under CC BY 4.0. / Text version added.

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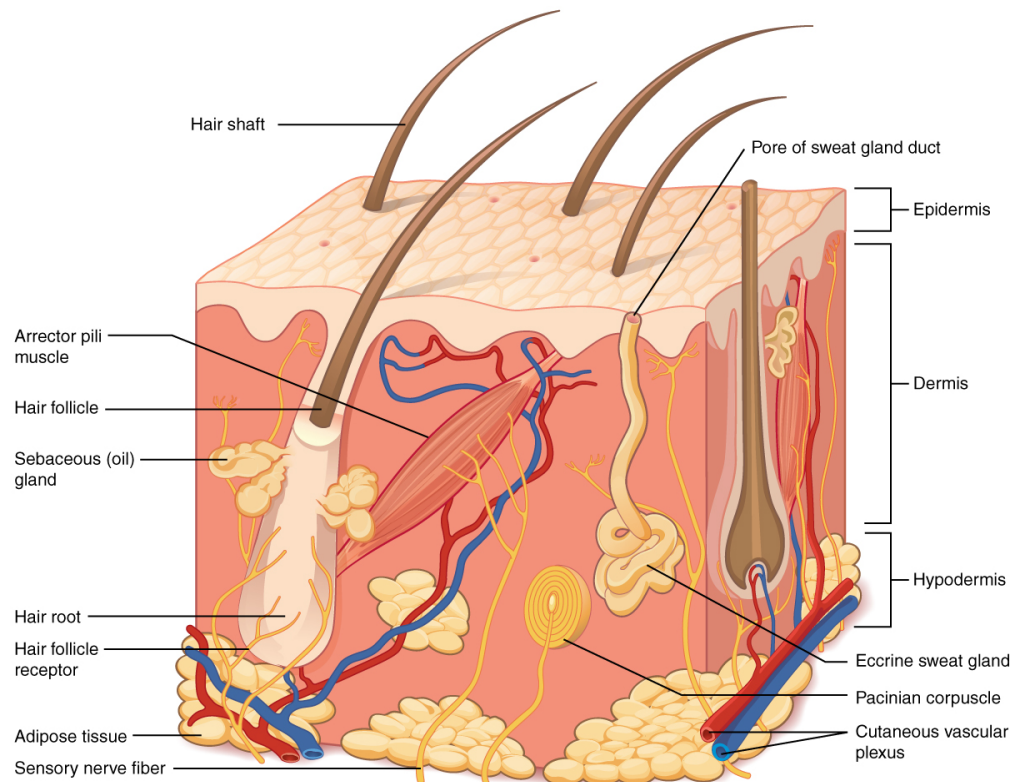
## 3.2 - Anatomy (Structures) of the Integumentary System

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. The deeper layer of skin is well **vascularized**. It also has numerous sensory, and **autonomic** and **sympathetic** nerve fibers ensuring communication to and from the brain.

### Layers of the skin

The skin is composed of three main layers:

1. The **epidermis**
2. The **dermis**
3. Beneath the dermis lies the **hypodermis**



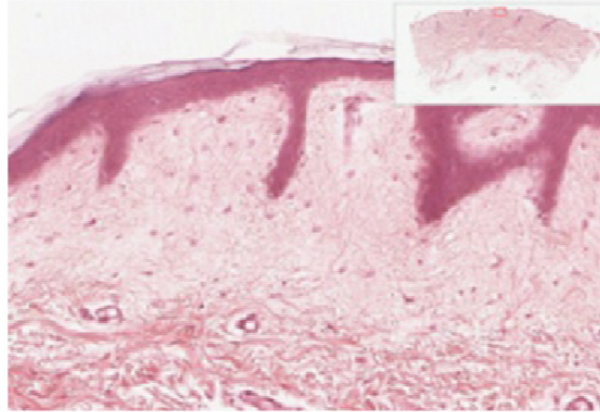
**Figure 3.1 Layers of Skin.** From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 3.1 Image description.]

## Concept Check

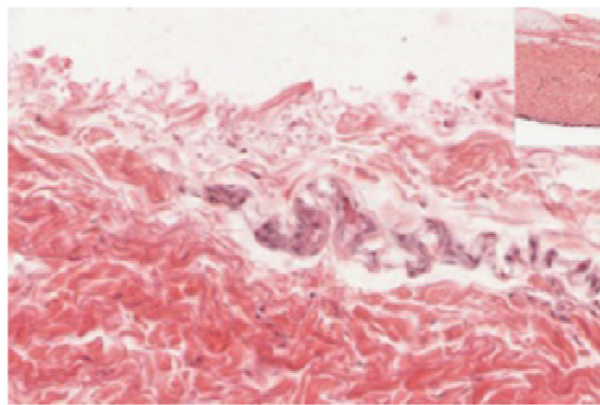
- On the diagram above, find the two layers of the skin; **epidermis** and **dermis**.
- The literal breakdown for **hypodermis** is below the dermis. On the diagram above, where can you locate it?
- Can you find a **hair follicle**, **hair root**, and **hair shaft**?
- Keep reading to find out what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

## Epidermis

- **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 3.2).



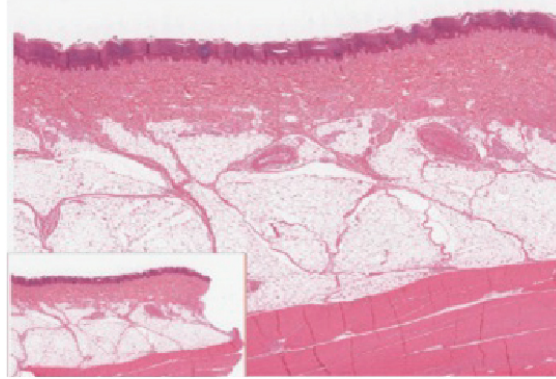
(a)



(b)

**Figure 3.2 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 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. [Fig. 3.2 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 3.3).



**Figure 3.3 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. [Fig. 3.3 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 3.4).



**Figure 3.4 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 image by kilbad, PDM). From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 3.4 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 3.4). Within the papillary layer are fibroblasts, a small number **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. This layer also contains lymphatic capillaries, nerve fibers, and **Meissner corpuscles**.

## Reticular Layer

Underlying the papillary layer is the much thicker reticular layer, composed of dense, irregular connective tissue. This 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

The **hypodermis** 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.

# Layers of the Skin

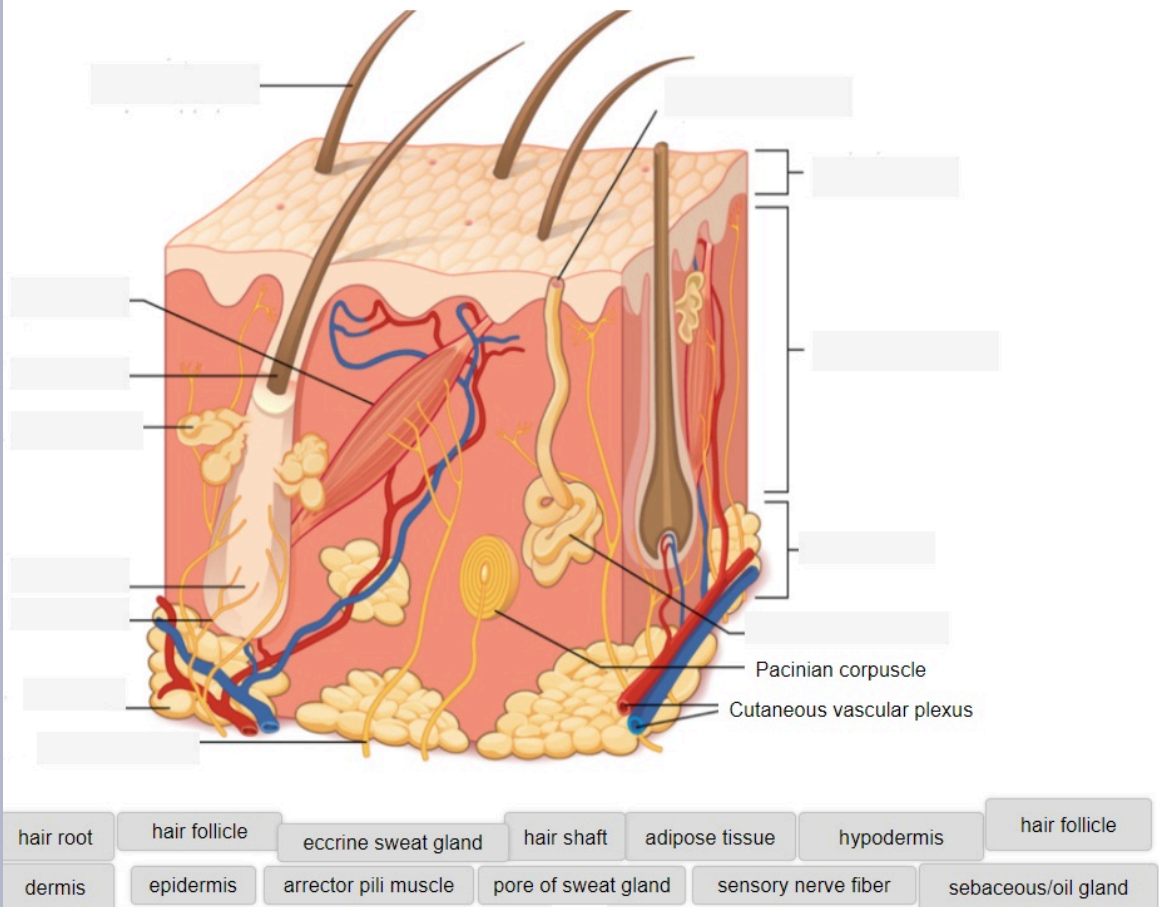
Practice labeling the layers of the skin.

### Layers of the Skin (Text Version)

Label the diagram with correct words listed below:

- |                        |                          |                         |
|------------------------|--------------------------|-------------------------|
| 1. Hair Root           | 6. Hypodermis            | 11. pore of sweat gland |
| 2. Hair Follicle       | 7. Hair follicle         | 12. sensory nerve fiber |
| 3. Eccrine Sweat Gland | 8. dermis                | 13. sebaceous/oil gland |
| 4. Hair shaft          | 9. epidermis             |                         |
| 5. Adipose tissue      | 10. arrector pili muscle |                         |

## Integumentary System Anatomy of a Skin Cube



### Layers of the Skin Diagram (Text Version)

This illustration shows a cross section of skin tissue. The outermost layer is called the \_\_\_\_\_ [Blank 1] 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 \_\_\_\_\_ [Blank 2]. The \_\_\_\_\_ [Blank 3] is located above the hair follicle. Surrounding the base of the hair follicle is the \_\_\_\_\_ [Blank 4] which lubricates the \_\_\_\_\_ [Blank 5]. Extending the surface of the skin is the \_\_\_\_\_ [Blank 6]. The middle layer is called the \_\_\_\_\_ [Blank 7], which occupies four fifths of the cross section. The dermis contains an \_\_\_\_\_ [Blank 8] that causes contraction of the hair follicle making the hair stand on end such as when someone experiences goosebumps. The dermis also contains an \_\_\_\_\_ [Blank 9], composed of a bunch of tubules. One tubule travels up from the bunch, through the epidermis, opening onto the surface a \_\_\_\_\_ [Blank 10]. There are two string-like nerves travelling vertically through the dermis. The right nerve is attached to a Pacinian corpuscle, which is a yellow structure consisting of concentric ovals like an onion. The lowest level of the skin, the \_\_\_\_\_ [Blank 11], contains \_\_\_\_\_ [Blank 12], arteries, and veins. Blood vessels travel from the hypodermis and connect to hair follicles and erector pili muscle in the dermis. \_\_\_\_\_ [Blank 13] located in the hypodermis supports the interpretation of touch.



### Check your answers: <sup>1</sup>

**Activity source:** Layers of the Skin by Kimberlee Carter from *Building a Medical Terminology Foundation*, illustration from *Anatomy and Physiology (OpenStax)*, licensed under CC BY 4.0./ Text version added.

## Image Descriptions

**Figure 3.1 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 erector pilli 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 a pore. There are two string-like nerves travelling 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 erector pilli muscle in the dermis. [Return to Figure 3.1].

**Figure 3.2 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 3.2].

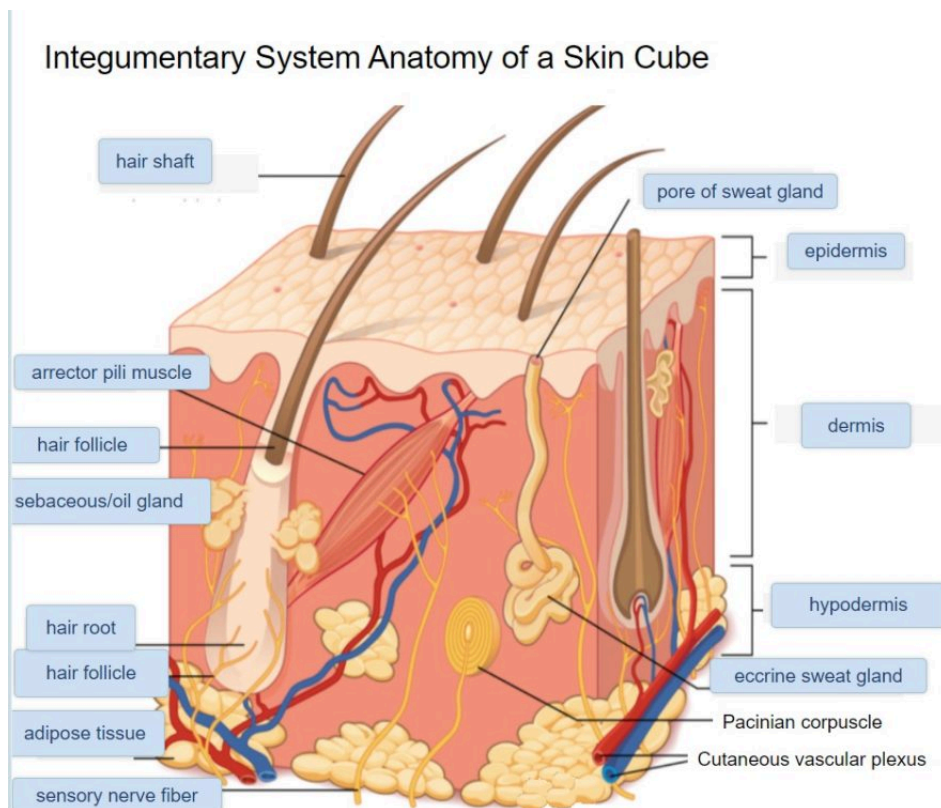
**Figure 3.3 image description:** The outer layer of cells in this micrograph is the thinnest layer and stained deep purple due to full keratinization of dead cells. The next layer occupies one quarter of the micrograph, is lightly stained, and is a dense collection of cells. The third layer from the top is mostly white, with lightly stained, loosely-packed strands radiating in random directions. The bottom-most layer is densely-packed, with thick bands of highly organized muscle tissue that are darkly stained. [Return to Figure 3.3].

**Figure 3.4 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 3.4].

## Attribution

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## Notes



1.

Check

**your answers: Layers of the Skin Diagram (Text Version)** 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 **hair follicle**. The **hair root** is located above the hair follicle. Surrounding the base of the hair follicle is the **sebaceous/oil gland** which lubricates the **hair follicle**. Extending the surface of the skin is the **hair shaft**. The middle layer is called the dermis, which occupies four fifths of the cross section. The dermis contains an **arrector pili muscle** that causes contraction of the hair stand on end such as when someone experiences goosebumps. 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 a **pore of sweat gland**. There are two string-like nerves travelling vertically through the dermis. The right nerve is attached to a Pacinian corpuscle, which is a yellow structure consisting of concentric ovals like an onion. The lowest level of the skin, the **hypodermis**, contains **adipose tissue**, arteries, and veins. Blood vessels travel from the hypodermis and connect to hair follicles and erector pili muscle in the dermis. **Sensory nerve fibers** located in the hypodermis supports the interpretation of touch.

## 3.3 - 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 dermicidin, which has antibiotic properties.

### Sensory Function

The skin acts as a sense organ because the epidermis, dermis, and the 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 can dissipate through the skin and into the surrounding environment.
- This accounts for the skin redness that many people experience when exercising.

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**.

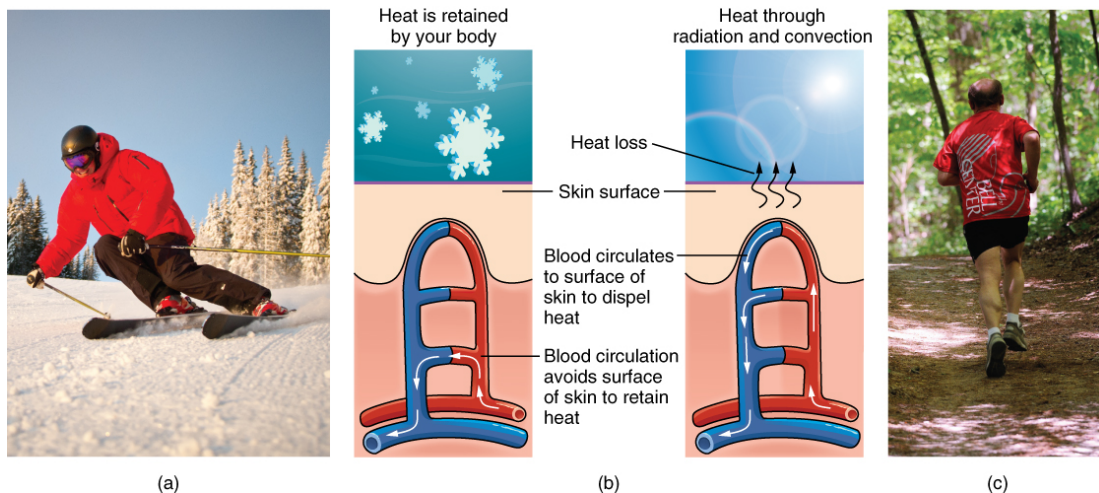


Figure 3.5 Thermoregulation. During strenuous physical activities, such as skiing (a) or running (c), the dermal blood vessels dilate and sweat secretion increases (b). These mechanisms prevent the body from overheating. In contrast, the dermal blood vessels constrict to minimize heat loss in response to low temperatures (b). (credit a: "Trysil"/flickr; credit c: Ralph Daily). From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 3.5 Image description.]

## Concept Check

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

- When body temperature is too warm.
- When 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 normal absorption of calcium and phosphorous, 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.

## Image Descriptions

**Figure 3.5 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 3.5].

## Attribution

Except where otherwise noted, this chapter is adapted from “Integumentary System (<https://ecampusontario.pressbooks.pub/medicalterminology/chapter/integumentary-system/>)” in *Building a Medical Terminology Foundation* by Kimberlee Carter and Marie Rutherford licensed under CC BY 4.0. / A derivative of Betts et al., which can be accessed for free from *Anatomy and Physiology (OpenStax)* (<https://openstax.org/books/anatomy-and-physiology/pages/1-introduction>). Adaptations: dividing Integumentary System chapter content into sub-chapters.

## 3.4 - 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 the hair root. The hair root ends deep in the dermis at the hair bulb, and includes a layer of mitotically 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 3.6).

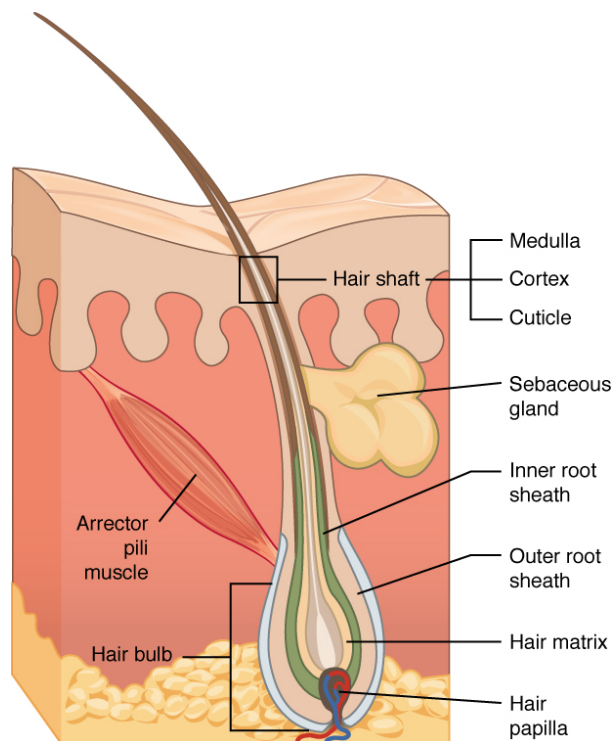


Figure 3.6 Hair. Hair follicles originate in the epidermis and have many different parts. From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 3.6 Image description.]

## 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 goose bumps and even more obvious in animals, such as when a frightened cat raises its fur. Of course, this is much more obvious in organisms with a heavier coat than most humans, such as dogs and cats.

### 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 Colour

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 colour 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 3.7). 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, also called the eponychium.

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.

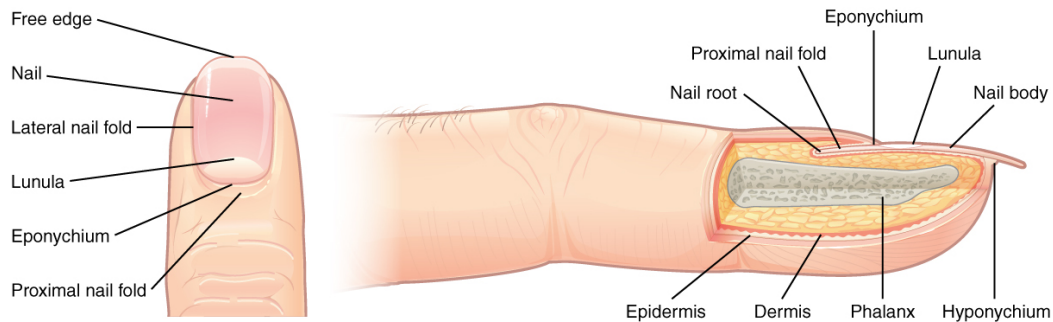


Figure 3.7 Nails. The nail is an accessory structure of the integumentary system. From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 3.7 Image description.]

## 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 excreted 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 a 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 3.8). 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 dermicidin, an antimicrobial peptide. **Eccrine glands** are a primary component of thermoregulation in humans and thus help to maintain **homeostasis**.

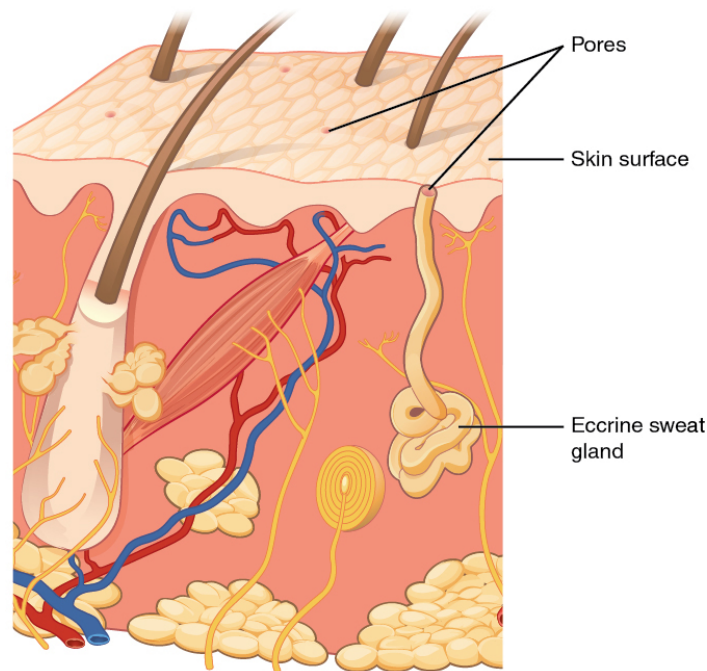


Figure 3.8 Eccrine Gland. Eccrine glands are coiled glands in the dermis that release sweat that is mostly water. From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 3.8 Image description.]

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.

## Did You Know?

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

## 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.

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 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.

## Words Not Easily Broken into Word Parts

### Integumentary System Terms Not Easily Broken into Word Parts

#### Integumentary Medical Terms (Text version)

1. **abscess**

- AB-ses (Original Term)
  - localized collection of pus
2. **abrasion**
- ă-BRĀ-zhŏn (Original Term)
  - scrape (by injury or mechanical process)
3. **acne**
- AK-nē
  - clogging of pores, which can lead to infection and inflammation
4. **adipocytes**
- AD-ĭ-pō-sĭts
  - Fat cells
5. **adipose**
- AD-ĭ-pōs
  - Fat tissue
6. **albinism**
- AL-bĭ-nizm
  - genetic disorder that affects the coloring of skin, hair, and eyes.
7. **apocrine sweat gland**
- AP-ŏ-krĕn swet gland
  - A type of gland that is found in the skin, breast, eyelid, and ear
8. **autonomic**
- ot-ŏ-NOM-ik
  - unconsciously regulates
9. **bacteria, bacterium**
- bak-TĒR-ē, bak-TĒR-ē-ŭm (Original Term)
  - single-celled microorganisms that reproduce by cell division and may cause infection by invading body tissue
10. **basal cell carcinoma (BCC)**
- BĀ-sāl sel kar-sĭn-Ō-ma
  - form of cancer that affects the mitotically active stem cells in the stratum basale of the epidermis
11. **benign**

- bē-NĪN
  - Noncancerous, harmless
12. **cancer**
- KAN-sĕr
  - A process where abnormal cells in the body divide uncontrollably
13. **cauterize, cauterization**
- KAW-tĕr-ĭz (Original Term)
  - to burn tissues by various means with the intent destroy damaged tissues, prevent infections or coagulate blood vessels
14. **cellulitis**
- sel-yŭ-LĪT-ĭs (Original Term)
  - bacterial infection of the skin and subcutaneous tissue, characterized by redness, pain, heat and swelling
15. **contusion**
- kŏn-TOO-zhŏn (Original Term)
  - bruise
16. **cyanosis**
- sĭ-ă-NŌ-sĭs
  - Abnormal condition of blue (bluish colour, lips and nail beds). Typically caused by low oxygenation
17. **cyst**
- sist (Original Term)
  - closed sac containing fluid or semisolid material
18. **debride, debridement**
- di-BRĒD, di-BRĒD-mĕnt (Original Term)
  - remove damaged tissues and cell debris from a wound or burn to prevent infection and promote healing.
19. **dehydration**
- dĕ-hĭ-DRĀ-shŏn
  - Loss of fluids/water is greater than what is taken in.
20. **dendritic cells**
- den-DRIT-ik

- pertaining to dendrites
21. **dermabrasion**
    - DĚRM-ă-brā-zhŏn (Original Term)
    - procedure to remove superficial scars using sandpaper or revolving wire brushes.
  22. **diaphoresis**
    - dī-ă-fŏ-RĒ-sīs (Original Term)
    - condition of profuse, excessive sweating
  23. **eccrine sweat gland**
    - ĚK-rĭn swet gland
    - type of gland that produces a hypotonic sweat for thermoregulation
  24. **eczema**
    - eg-ZĚ-mă (Original Term)
    - noninfectious, inflammatory disease presents as redness, blisters, scabs and itching
  25. **edema**
    - ě-DĚ-mă (Original Term)
    - puffy swollen tissue due to accumulation of fluid
  26. **excise, excision**
    - ěk-SĪZ, ek-SIZH-ŏn (Original Term)
    - surgical removal by cutting out
  27. **fascia**
    - FASH-ĕ-ă
    - Fibrous tissue
  28. **frostbite**
    - FROST-bĭt
    - Conservation of core body heat results in the skin actually freezing
  29. **gangrene**
    - GANG-grĕn (Original Term)
    - death of tissue due to blood supply loss
  30. **incise, incision**
    - in-SĪZ, in-SIZH-ŏn (Original Term)
    - surgical cut into or wound produced by a sharp instrument

31. **incision and drainage (I&D)**

- in-SIZH-ǒn & DRĀN-ǎj
- surgical cut made to allow the free flow of fluids from a lesion, wound, or cavity

32. **infection**

- in-FEK-shǒn (Original Term)
- invasion of pathogens to body tissue

33. **jaundice, jaundiced**

- JON-dīs, JON-dīsd (Original Term)
- yellow colouring of the mucous membranes and sclera

34. **keloid**

- (KĒ-loyd)
- Formation of a raised or hypertrophic scar

35. **keratin**

- (KER-ăt-in)
- intracellular fibrous protein that gives hair, nails, and skin their hardness and water-resistant properties

36. **keratinocyte**

- kĕ-RĀT-ī-nō-sīt
- Cell that manufactures and stores the protein keratin

37. **laceration**

- las-ĕ-RĀ-shǒn (Original Term)
- torn, ragged-edged wound

38. **laser surgery**

- LĀ-zĕr SŪRJ-ĕ-rĕ
- A surgical procedure using a powerful beam of light to cut or burn tissue.

39. **Lesion**

- lĒ-zhǒn (Original Term)
- visible change in tissue resulting from injury or disease

40. **leukoplakia**

- loo-kō-PLĀ-kĕ-ǎ
- white, thickened patches on mucus membrane tissue of the tongue or cheek

41. **macule**
  - MAK-ŭl (Original Term)
  - flat, coloured spot on the skin
42. **Meissner corpuscle**
  - MĪS-nĕr KOR-pŭs-ĕl
  - Tactile corpuscle that responds to light and touch, touch receptor
43. **melanoma**
  - mel-ă-NŌ-mă
  - cancer characterized by uncontrolled growth of melanocytes
44. **metastasize**
  - mĕ-TĂS-tă-sĭz
  - Production of cells that can mobilize and establish tumors in other organs of the body
45. **nevus**
  - NĒ-vŭs (Original Term)
  - a pigmented skin blemish
46. **nodule**
  - NOJ-ool (Original Term)
  - a small node-like structure
47. **Pacinian corpuscle**
  - pă-SIN-ĕ-ăn KOR-pŭs-ĕl
  - Lamellated corpuscle that responds to vibration
48. **pallor**
  - PĂL-or (Original Term)
  - paleness
49. **pathogens**
  - path-Ō-jĕns
  - Disease-causing agents
50. **phagocytes**
  - făg-ō-SĪTS
  - Cells that engulf and absorb bacteria and cell particles
51. **pruritus**



- proo-RĪT-ūs (Original Term)
  - itching
52. **psoriasis**
- sŏ-RĪ-ă-sīs
  - chronic autoimmune disorder that results in patches of thick red skin with the appearance of silvery scales
53. **pustule**
- PŪS-tŭl (Original Term)
  - small elevation of the skin containing fluid
54. **reticulated**
- rĕ-TIK-yŭ-lăt-ĕd
  - constructed, arranged, or marked like a net or network.
55. **rickets**
- RIK-ĕts
  - A painful condition in children where bones are misshapen due to a lack of calcium, causing bow leggedness
56. **scar**
- skăr
  - Collagen-rich skin formed after the process of wound healing that differs from normal skin. Also known as a cicatrix.
57. **sebaceous gland**
- sĕ-BĀ-shŭs gland
  - type of oil gland that is found all over the body and helps to lubricate and waterproof the skin and hair.
58. **squamous cell carcinoma (SCC)**
- SKWĀ-mŭs sel kar-sĭn-Ō-mă
  - cancer that affects the keratinocytes of the stratum spinosum and presents as lesions commonly found on the scalp, ears, and hands
59. **stratum basale**
- STRĀ-tŭm BĀS-al
  - Deepest layer of the epidermal
60. **suture**

- SOO-chŭr
- to stitch the edges of a wound

61. **sympathetic**

- sĭm-pă-THĚT-ĭk
- Flight or fight response

62. **Sympathetic Nervous System**

- sĭm-pă-THĚT-ĭk NĚR-vŭs SIS-tĕm
- Responsible for fight or flight responses

63. **tinea**

- TIN-ĕ-ă (Original Term)
- A group of fungal skin diseases, characterized by itching, scaling, and sometimes painful lesions.

64. **vascularized**

- VAS-kyŭ-lă-rĭzd
- Has numerous blood vessels

65. **verruca**

- vĕr-ROO-kă
- Also known as a wart. An epidermal growth caused by a virus.

66. **virus**

- VĪ-rŭs (Original Term)
- minute microorganism that may cause infection by invading body tissue

**Activity Source:** Integumentary Medical Terms from *Medical Terminology* by Grimm et al., licensed under CC BY 4.0. /Re-recording of some H5P audio by Tania Deane and David McCuaig and text version added.

## Common Integumentary System Abbreviations

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

### Integumentary System Common Abbreviations

- **BCC** (basal cell carcinoma)
- **SCC** (squamous cell carcinoma)
- **SLE** (systemic lupus erythematosus)
- **staph** (staphylococcus)
- **strep** (streptococcus)
- **subcut** (subcutaneous)
- **ID** (intra-dermal)
- **TD** (transdermal)
- **derm** (dermatology)
- **bx** (biopsy)
- **MRSA** (methicillin-resistant *Staphylococcus aureus*)

**Activity source:** Integumentary System Common Abbreviations by Jesslyn Wilkinson, licensed under CC BY 4.0./ Converted to text.

## Image Description

**Figure 3.6 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 envelope 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 3.6].

**Figure 3.7 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 grows distally out from the proximal nail fold. The lower image shows a lateral view of the nail bed anatomy. In this view, one can see how the edge of the nail is located just proximal to the nail fold. This end of the nail, from which the nail grows, is called the nail root. [Return to Figure 3.7].

**Figure 3.8 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 on to 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 3.8].

## Attribution

Except where otherwise noted, this chapter is adapted from “Integumentary System (<https://ecampusontario.pressbooks.pub/medicalterminology/chapter/integumentary-system/>)” in *Building a Medical Terminology Foundation* by Kimberlee Carter and Marie Rutherford licensed under CC BY 4.0. / A derivative of Betts et al., which can be accessed for free from *Anatomy and Physiology (OpenStax)* (<https://openstax.org/books/anatomy-and-physiology/pages/1-introduction>). Adaptations: dividing Integumentary System chapter content into sub-chapters.

## 3.5 - Integumentary System Changes (Aging, Disease and Disorders, Skin)

### 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 3.9). 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 3.9 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. The differences are shown in the image from a young woman in the right panel and an older woman in the left panel. (credit: "Granddaughter and Grandmother" by Janet Ramsden is licensed under CC BY 2.0 (<http://creativecommons.org/licenses/by/2.0>)). From Betts et al., 2013. [Fig. 3.9 Image description.]*

## Did You Know?

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

## Disease and Disorders

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.

One of the most talked about diseases is skin **cancer**. Most cancers are identified by the organ or tissue in which the cancer originates. One common form of cancer is skin cancer.

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.

## Sun Damage

It requires about 10 days after initial sun exposure for melanin synthesis to peak, 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 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 3.10).

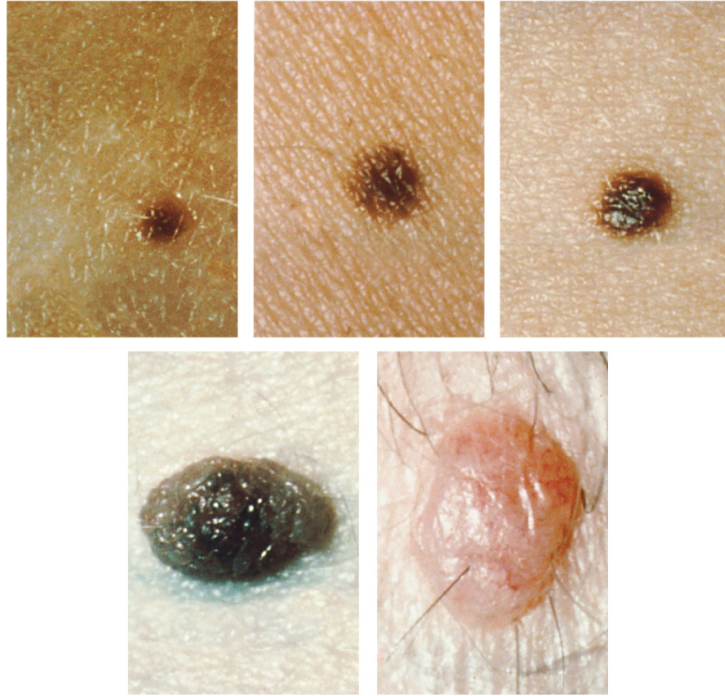


Figure 3.10 Moles. Moles range from benign accumulations of melanocytes to melanomas. These structures populate the landscape of our skin. (credit: Image by the National Cancer Institute, PDM). From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 3.10 Image description.]

## 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 as that are 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, etc. 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 3.11). Like most cancers, basal cell carcinomas respond

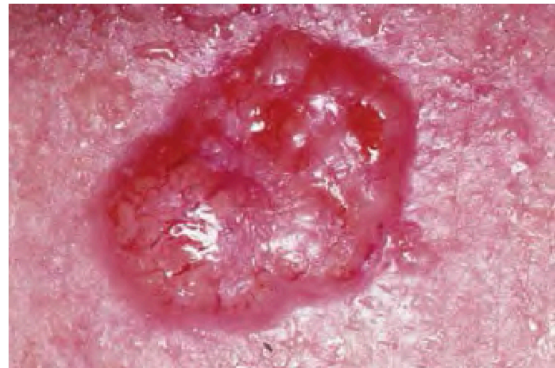


Figure 3.11 Basal Cell Carcinoma. Basal cell carcinoma can take several different forms. In this form it appears reddened, raised and shiny. Similar to other forms of skin cancer, it is readily cured if caught early and treated. [Fig. 3.11 Image Description](credit: John Hendrix, MD, PDM). From Betts et al., 2013. Licensed under CC BY 4.0.

best to treatment when caught early. Treatment options include surgery, freezing (cryosurgery), and topical ointments.

## Squamous Cell Carcinoma (SCC)

Squamous cell carcinoma is a cancer that affects the keratinocytes of the stratum spinosum and presents as lesions commonly found on the scalp, ears, and hands (see Figure 3.12). 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 3.12 Squamous Cell Carcinoma Squamous cell carcinoma presents here as a lesion on a nose. (credit: Image by the National Cancer Institute, PDM). From Betts et al., 2013. Licensed under CC BY 4.0.

## Melanoma



Figure 3.13 Melanoma. Melanomas typically present as large brown or black patches with uneven borders and a raised surface. (credit: Image by the National Cancer Institute, PDM). From Betts et al., 2013. Licensed under CC BY 4.0.

A melanoma is a 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 3.13). Treatment typically involves surgical excision and immunotherapy.



## *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:

- **Elevated** – it is raised on the skin surface
- **Firm** – it feels hard to the touch
- **Growing** – it is getting larger

## **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 (Betts et al., 2013).

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 3.14). Neither albinism nor vitiligo directly affects the lifespan of an individual (Betts et al., 2013).



Figure 3.14 Vitiligo. Individuals with vitiligo experience depigmentation that results in lighter colored patches of skin. The condition is especially noticeable on darker skin. (credit: Image by Klaus D. Peter, CC BY 3.0 Germany).

## Changes in Skin Colouration

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

- Liver disease or liver cancer can cause the accumulation of bile and the yellow pigment bilirubin, leading to the skin appearing **yellow** or **jaundiced**.
- 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 adrenocorticotropic 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).
- 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 (Betts et al., 2013).

## Skin Disorders

Two common skin disorders are **eczema** and **acne**. Eczema is an inflammatory condition that 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 (Betts et al., 2013).

### Eczema

Eczema is an allergic reaction that manifests as dry, itchy patches of skin that resemble rashes (see Figure 3.15). 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 (Betts et al., 2013).



Figure 3.15 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.

### Acne

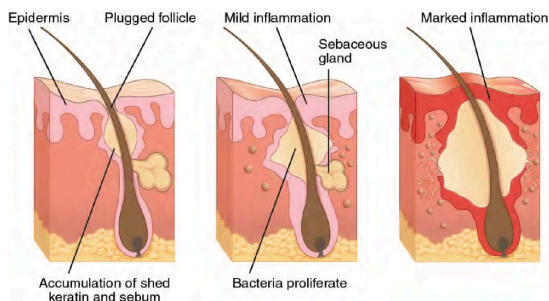


Figure 3.16. Acne. Acne is a result of over-productive sebaceous glands, which leads to formation of blackheads and inflammation of the skin. From Betts et al., 2013. Licensed under CC BY 4.0.

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. An 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 3.16) (Betts et al., 2013).

## 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 where it is found:

- **Tinea pedis:** feet or 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, 2018a).

To learn more about ringworm, visit the Center for Disease Control and Prevention's web page on fungal infections [New Tab]. (<https://www.cdc.gov/fungal/diseases/ringworm/definition.html>)

## 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, lower 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, 2018). To learn more, visit the Canadian Association of Psoriasis Patients' page on psoriasis and inflammation [New Tab] (<https://www.canadianpsoriasis.ca/en/psoriasis/what-is-psoriasis/psoriasis-and-inflammation>).

## 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**, as well as **scars** and **calluses**. They can be caused by sharp objects, heat, excessive pressure or friction to the skin (Betts et al., 2013).

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 (Betts et al., 2013).

## 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 intravenous 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 skin is extremely susceptible to bacteria and other **pathogens**, due to the loss of protection by intact layers of skin (Betts et al., 2013).

### *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 3.17) (Betts et al., 2013).

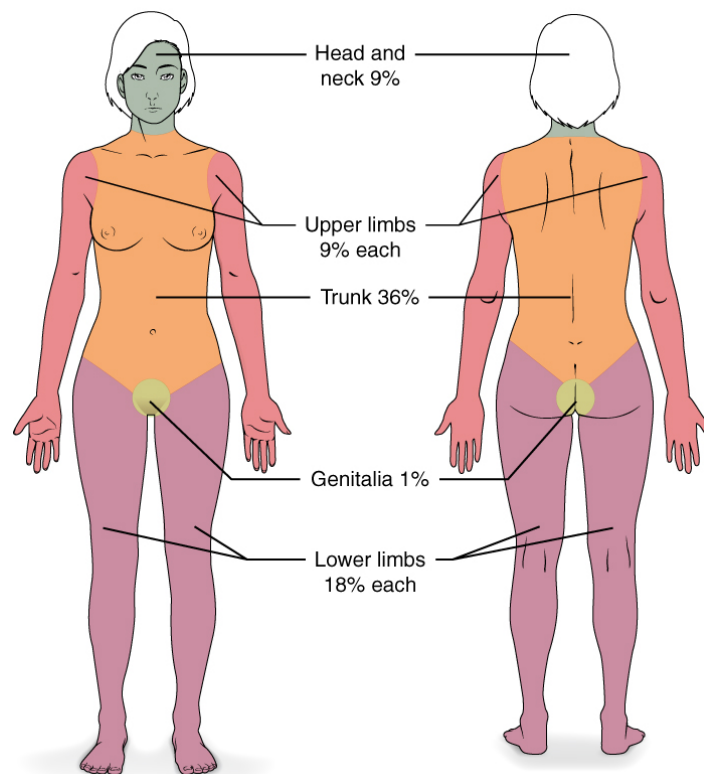


Figure 3.17 Calculating the Size of a Burn. The size of a burn will guide decisions made about the need for specialized treatment. Specific parts of the body are associated with a percentage of body area. From Betts et al., 2013. Licensed under CC BY 4.0. [Fig. 3.17 Image description.]

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 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.
- A **fourth-degree** burn is even more severe, affecting the underlying muscle and bone.

Oddly, third and fourth-degree burns are usually not as painful because the nerve endings themselves 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 (Betts et al., 2013).

## 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 (Betts et al., 2013).

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 (Betts et al., 2013)

Scarring of skin after wound healing is a natural process and does not need to be treated further. The 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 (Betts et al., 2013).

## Bedsore and Stretch Marks

Skin and its underlying tissue can be affected by excessive pressure. One example of this is called a bedsore. Bedsore, 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**. Bedsore 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 (Betts et al., 2013)

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 have a reddish hue, but lighten over time. Other than for cosmetic reasons, treatment of stretch marks is not required. They occur most commonly over the hips and abdomen (Betts et al., 2013).

## 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 independent 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 (Betts et al., 2013).

## Integumentary System Medical Terms In Use

### Medical Terms in Context: Consultation Report

#### Consultation Report (Text Version)

#### INTEGUMENTARY SYSTEM – CONSULTATION REPORT

Fill in the consultation report with using the following words:

- Excisional
- Lesion
- Asymmetrical
- Mole
- Benign
- Biopsy
- Irregular

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

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 \_\_\_\_\_[Blank 1] with smooth borders that appeared \_\_\_\_\_[Blank 2]. Ms. Coombs recently went to Dr. Sharpe for a physical and the \_\_\_\_\_[Blank 3] 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 \_\_\_\_\_[Blank 4] in shape. It is mainly dark brown, with regions of darker black. The borders are \_\_\_\_\_[Blank 5] 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 \_\_\_\_\_[Blank 6] biopsy. I will then send the specimen for a \_\_\_\_\_[Blank 7]. Another follow up appointment will be made once I receive the results of the biopsy.

-----  
Donna Brown, MD, Dermatology

**Note:** Report samples (H5P and Pressbooks) are to encourage learners to identify correct medical terminology and do not represent the Association for Health Documentation Integrity (AHDI) formatting standards.

**Check your answers:**<sup>1</sup>

**Activity source:** Integumentary system – consultation report by Heather Scudder, licensed under CC BY 4.0./Text version added.

## Medical Terminology in Text

### Medical Terminology (Text version)

Fill in the spaces below with the following terms:

- Xero
- o
- hidr
- rhytid
- ous
- genic



- logist
- o
- ectomy
- derma
- cutane
- itis
- ous
- o
- al
- necr

- o
- o
- plasty
- sis
- phagia
- tone
- trans
- sub
- cutane
- dermat

- derma
- kerat
- aden
- auto
- derm
- per
- onych
- dermat

\_\_\_\_\_[Blank 1a] / \_\_\_\_\_ [Blank 2a] / \_\_\_\_\_ [Blank 3a] / \_\_\_\_\_ [Blank 4a] refers to the surgical repair of one's own skin.

Something that generates the production of epidermal tissues might be called \_\_\_\_\_ [Blank 2a] / \_\_\_\_\_ [Blank 2b] / \_\_\_\_\_ [Blank 2b].

\_\_\_\_\_[Blank 3a] / \_\_\_\_\_ [Blank 3b] / \_\_\_\_\_ [Blank 3c] refers to something in state of death.

\_\_\_\_\_[Blank 4a] / \_\_\_\_\_ [Blank 4b] / \_\_\_\_\_ [Blank 4c] is a technical name for finger-biting.

\_\_\_\_\_[Blank 5a] / \_\_\_\_\_ [Blank 5b] / \_\_\_\_\_ [Blank 5c] means pertaining to through the skin.

\_\_\_\_\_[Blank 6a] / \_\_\_\_\_ [Blank 6b] / \_\_\_\_\_ [Blank 6c] injection is given under the skin.

During the winter months many people complain of \_\_\_\_\_ [Blank 7a] / \_\_\_\_\_ [Blank 7b] 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 \_\_\_\_\_ [Blank 8a] / \_\_\_\_\_ [Blank 8b] / \_\_\_\_\_ [Blank 8c] patch.

An instrument use to cut the skin for biopsy is referred to as a \_\_\_\_\_ [Blank 9a] / \_\_\_\_\_ [Blank 9b].

A specialist who studies and treats disorders and diseases of the skin is referred to as a \_\_\_\_\_ [Blank 10a] / \_\_\_\_\_ [Blank 10b] / \_\_\_\_\_ [Blank 10b].

The medical term that means a sweat gland is inflamed is \_\_\_\_\_ [Blank 11a] / \_\_\_\_\_ [Blank 11b] / \_\_\_\_\_ [Blank 11c].

The medical term to excise wrinkles or commonly referred to as a facelift is \_\_\_\_\_ [Blank 12a] / \_\_\_\_\_ [Blank 12b].

**Check your answers:** <sup>2</sup>

**Activity source:** Integumentary Medical Terms by Jesslyn Wilkinson, licensed under CC BY 4.0./Text version added.

## 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 Dermatology and Subspecialties section [New Tab] (<https://dermatology.ca/public-patients/about-dermatology/dermatology-and-subspecialties/>) of the Canadian Dermatology Association website.

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 (Mayo Clinic Staff, 2017).

## Image Descriptions

**Figure 3.9 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 3.9].

**Figure 3.10 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 3.10].

**Figure 3.11 image description:** The image shows a section of skin tissue with a raised reddened growth in a circular shape with irregular margins. The raised area is shiny. In this appearance the growth appears to be a basal cell carcinoma. [Return to Figure 3.11]

**Figure 3.17 image description:** This diagram depicts the percentage of the total body area burned when 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 3.17].

## Attribution

Except where otherwise noted, this chapter is adapted from “Integumentary System (<https://ecampusontario.pressbooks.pub/medicalterminology/chapter/integumentary-system/>)” in *Building a Medical Terminology Foundation* by Kimberlee Carter and Marie Rutherford licensed under CC BY 4.0. / A derivative of Betts et al., which can be accessed for free from *Anatomy and Physiology (OpenStax)* (<https://openstax.org/books/anatomy-and-physiology/pages/1-introduction>). Adaptations: dividing Integumentary System chapter content into sub-chapters.

## Notes

1. Mole, 2. Benign, 3. Lesion, 4. Asymmetrical, 5. Irregular, 6. Excisional, 7. Biopsy
2. 1. Dermat /o /auto /plasty. 2. Kerat /o /genic. 3. Necr /o /sis. 4. Onych /o /phagia. 5. Per /cutane /ous. 6. Sub /cutane /ous. 7. Xero /derma. 8. Trans /derm /al. 9. Derma /tone. 10. Dermat /o /logist. 11. Hidr /aden /itis. 12. Rhytid /ectomy.

# Vocabulary & Check Your Knowledge

## Integumentary System Vocabulary

### **Adipocytes**

Fat cells.

### **Adipose tissue**

Fat tissue.

### **Autonomic nerve fibers**

Unconsciously regulates communication to and from the brain.

### **Avascular**

Without blood vessels.

### **Benign**

Noncancerous, harmless.

### **Cancer**

A process where abnormal cells in the body divide uncontrollably.

### **Cyanosis**

Abnormal condition of blue (bluish colour, lips and nail beds). Typically caused by low oxygenation.

### **Debridement**

Excision of damaged tissue or foreign object.

### **Dehydration**

Loss of fluids/water is greater than what is taken in.

### **Dermatologic**

Pertaining to dermatology.

### **Dermatopathology**

Study of diseases 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.

**Epidermis**

Outer layer of skin, made of closely packed epithelial cells.

**Excises**

Remove by cutting out.

**Exocytosis**

Active transport of molecules out of the cell.

**Fascia**

Fibrous tissue.

**Frostbite**

Conservation of core body heat results in the skin actually freezing.

**Hypodermis**

Literally means below the dermis. The layer of skin below the dermis that is composed mainly of loose connective and fatty tissues.

**Infection**

Invasion by disease-causing organisms.

**Intravenous**

Pertaining to within the vein.

**Jaundiced**

Yellow-coloured.

**Keloid**

Formation of a raised or hypertrophic scar.

**Keratinocytes**

Cells that manufacture and store the protein keratin.

**Meissner corpuscle**

Tactile corpuscle that responds to light and touch, touch receptor.

**Meissner corpuscles**

Tactile corpuscle that responds to light and touch, touch receptors.

**Melanocytes**

Specialized cells that produce melanin which is a dark pigment responsible for the colouration of skin and hair.

**Metastasize**

Production of cells that can mobilize and establish tumors in other organs of the body.

**Necrosis**

Tissue death.

**Osteomalacia**

Softening of the bones.

**Pacinian corpuscle**

Lamellated corpuscle that responds to vibration.

**Pathogens**

Disease-causing agents.

**Phagocytes**

Cells that engulf and absorb bacteria and cell particles.

**Reticulated**

Net like.

**Rickets**

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

**Scar**

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

**Stratum Basale**

Deepest layer of the epidermal.

**Sympathetic nerve fibers**

Flight or fight response determines communication to and from the brain.

**Sympathetic Nervous System**

Responsible for fight or flight responses.

**Vascularized**

Has numerous blood vessels.

## Test Yourself

### Integumentary System Glossary Reinforcement Activity (Text version)

1. Cells that manufacture and store the protein keratin are called \_\_\_\_\_[Blank 1].
  - a. Scar
  - b. Vascularized
  - c. Keratinocytes
2. The outer layer of skin, made of closely packed epithelial cells are called\_\_\_\_\_ [Blank 2].
  - a. Fascia
  - b. Adipocytes
  - c. Epidermis
3. Specialized cells that produce melanin which is a dark pigment responsible for the colouration of skin and hair are called\_\_\_\_\_ [Blank 3].
  - a. Necrosis
  - b. Melanocytes
  - c. Keloid
4. Deepest layer of the epidermal is the \_\_\_\_\_[Blank 4].
  - a. Dermis
  - b. Fascia
  - c. Stratum Basale
5. Production of cells that can mobilize and establish tumors in other organs of the body are called \_\_\_\_\_[Blank 5].
  - a. Pathogens
  - b. Debridement
  - c. Metastasize

**Check your answers:** <sup>1</sup>

**Activity source:** Integumentary System Glossary Reinforcement Activity by Gisele Tuzon and Kimberlee Carter, licensed under CC BY 4.0./Text version added.

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## Notes

1. 1. Keratinocytes, 2. Epidermis, 3. Melanocytes, 4. Stratum Basale, 5. Metastasize

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