

The Skin

The **skin** is the primary organ of the *integumentary system* and is the largest organ of the body. Forming the outer protective covering of the body, the skin is a continuous sheet of **cutaneous membrane**.

Before you begin

- Read the appropriate chapter in your textbook.
- Set your learning goals. When you finish this exercise, you should be able to:
 - describe the major structures of the skin and identify their functions
 - identify important skin structures in a diagram, model, and prepared specimen
 - compare and contrast features of thick skin and thin skin
 - describe the gross structure of skin in a preserved mammalian specimen
- Prepare your materials:
 - model or chart of a skin cross section
 - microscope
 - prepared microslides:
 - thin skin section
 - thick skin section
 - hair follicles c.s.
 - preserved specimen: cat or fetal pig (unskinned)
 - dissection tools and trays
 - storage container (if specimen is to be reused)
- Read the directions and safety tips for this exercise *carefully* before starting any procedure.

A. Basic skin structure

First in a model, then in prepared microscopic specimens, identify the elements of skin structure described in the following steps:

SAFETY FIRST!

Don't forget the rules for safe use of the microscope.

- 1 The skin has two distinct layers. The superficial layer is a sheet of keratinized stratified squamous epithelium called the **epidermis**. The epidermis is itself divided into distinct histological regions or **strata** (meaning "layers"):
 - Stratum basale** is the deepest stratum of the epidermis. It consists of a single sheet of columnar cells that continue to divide. As the daughter cells are formed, they are pushed upward, becoming part of the next stratum.
 - Stratum spinosum** is noted for its multilayer of distorted ("spined") cells. The cells become distorted as they are pushed up from the deeper stratum basale. Stratum basale and stratum spinosum together are often called *stratum germinativum*.
 - Stratum granulosum** is superficial to stratum spinosum. It contains flattened cells pushed up from the deeper strata. As the cells are pushed up through this stratum, they form the protein granules that give it the name *granulosum*. By the time the cells leave this stratum, they have died.
 - Stratum lucidum** (meaning "light layer") is a very thin layer present only in **thick skin**. Thick skin is found only in high-wear areas such as the palms and soles. The more flexible **thin skin** is found over most other areas of the body. This stratum's name comes about because it is translucent, allowing light to pass through it easily.
 - Stratum corneum** is the layer of dead, keratinized tissue already identified in Lab Exercise 7. Stratum corneum is extremely thick in thick skin, providing a great deal of protection. Stratum corneum protects deeper tissues from mechanical injury, from inward or outward diffusion of water and other molecules, and from invasion by microorganisms.
- 2 The layer of skin deep to the epidermis is a sheet of irregular fibrous connective tissue called the **dermis**. The dermis is usually much thicker than the epidermis. Like most connective tissues, the dermis has a scattering of blood vessels and nerves. The blood vessels supply both the dermis and epidermis. Because blood cools when it travels through the skin, the body varies the amount of blood sent to the skin to regulate loss of heat by the entire body. The dermis contains many sensory nerve endings. Sensations such as *heat*, *cold*, *touch*, and *pressure* are mediated by dermal nerve endings. There are two regions of the dermis:

- The **reticular layer** of the dermis is a thick region of irregularly arranged protein fibers. Most of the fibers are collagenous, but a few are made of elastin.
- The **papillary layer** is the bumpy superficial portion of the dermis attached to the epidermis. The bumps, called **papillae** (meaning "nipples"), form regular rows in thick skin but are rather irregularly arranged in thin skin. For this reason, thick skin can be observed to have distinct ridges, such as fingerprints. These ridges give the hands and feet better gripping ability.

3 Deep to the skin is a layer of **subcutaneous tissue**, sometimes called the **hypodermis** or **superficial fascia**. Although not a part of the skin, it is often studied along with skin. Subcutaneous tissue is loose, fibrous (areolar) connective tissue that connects the skin to underlying muscles and bone. Some of the areolar tissue has been modified to become adipose tissue. Adipose tissue's protective and insulating characteristics complement the protection and temperature regulation roles of the skin.

NOTE

LABORATORY REFERENCE, Plates 29 to 33, show light micrographs of skin structures. Plates 29 and 30 show thin skin; Plate 31, thick skin; Plate 32, skin with hair follicles and other accessory structures; and Plate 33, thin skin with sweat glands.

Hair, nails, and glands

The skin has a variety of accessory structures, including **hair** and **nails**. Both hair and nails are modified forms of stratum corneum, or keratinized tissue. A hair is a cylinder of compact keratinized material, and a nail is a plate of compact keratinized material. Identify the structures described in the following in a model and in prepared specimens.

- 1 Each hair is formed within a separate **hair follicle**. The follicle is a sheathlike indentation of the epidermis (Figure 10-1). At the bottom of the follicle, a **hair papilla** covered with stratum germinativum produces the hair. The portion of each hair within the follicle is called the **hair root**, whereas the portion that has been pushed out of the follicle is called the **hair shaft**. The hair has a very dense cortex and a less dense medulla.

- 2 Attached to each follicle is an exocrine (ducted) sebaceous gland (see Figure 10-1). This gland produces the fatty substance, **sebum**, that coats the hair and skin. Sebum prevents moisture loss and conditions the hair and skin so that they do not become brittle and easily broken.
- 3 The **arrector pili** muscle is a strap of smooth muscle tissue connecting the side of a follicle to the superficial surface of the dermis. When contracted, the muscle pulls the follicle so that it is nearly perpendicular to the skin's surface (Figure 10-2). This increases the air spaces among the hairs, improving their insulation quality. Contraction of the arrector pili also dimples the epidermis, raising a ridge at the edge of the follicle (a "goose pimple" or "goose bump").
- 4 The toenail or fingernail is also formed by a modified portion of stratum germinativum. In the case of either hair or nail, this modified tissue is often called **matrix**. A portion of the **nail bed** (skin under the nail) is matrix that produces the nail plate. Part of the matrix may be visible through the nail as a pale crescent, or **lunula**. Nail formation begins under a fold of epidermis. The portion of the nail under the fold is the **root**, and the visible portion is the **nail body**. A **cuticle**, or **eponychium**, may extend from the fold onto the nail body (Figure 10-3).
- 5 **Sweat glands** are found in many areas of the skin. They are exocrine glands that produce a watery solution, **sweat**, that coats the skin. Sweat serves primarily to improve heat loss by the skin through evaporation. *Eccrine* sweat glands produce thin, watery sweat in many areas of the body. *Apocrine* sweat glands, found in the axillary and pubic regions, secrete a thicker sweat that is rich in complex organic molecules.

SAFETY FIRST!

Observe the usual precautions for dissection activities. Use gloves and take care to avoid injuries. Use safety goggles to avoid injury during dissections.

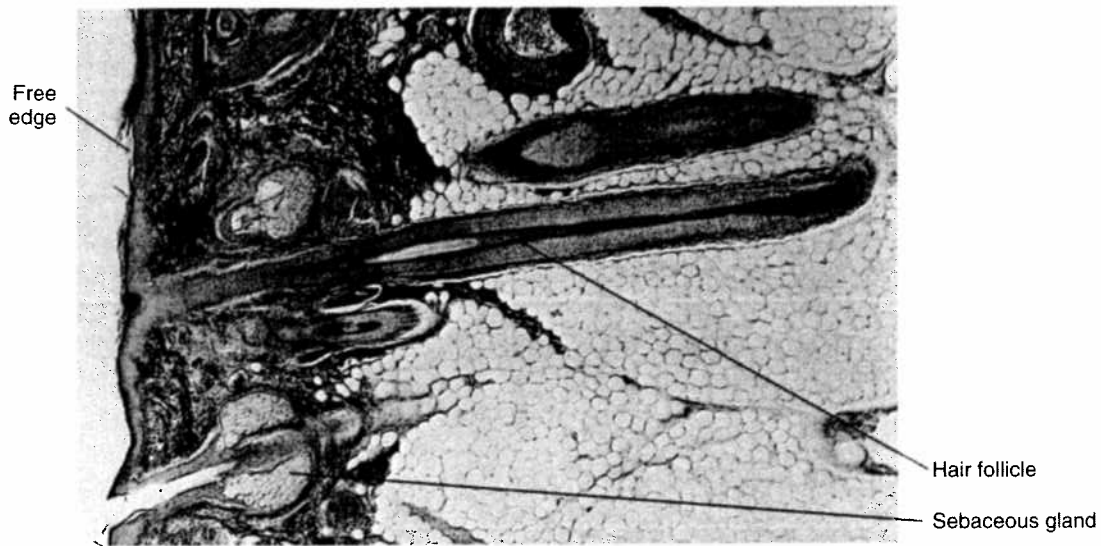


Figure 10-1 Hair follicle and sebaceous gland (200×).

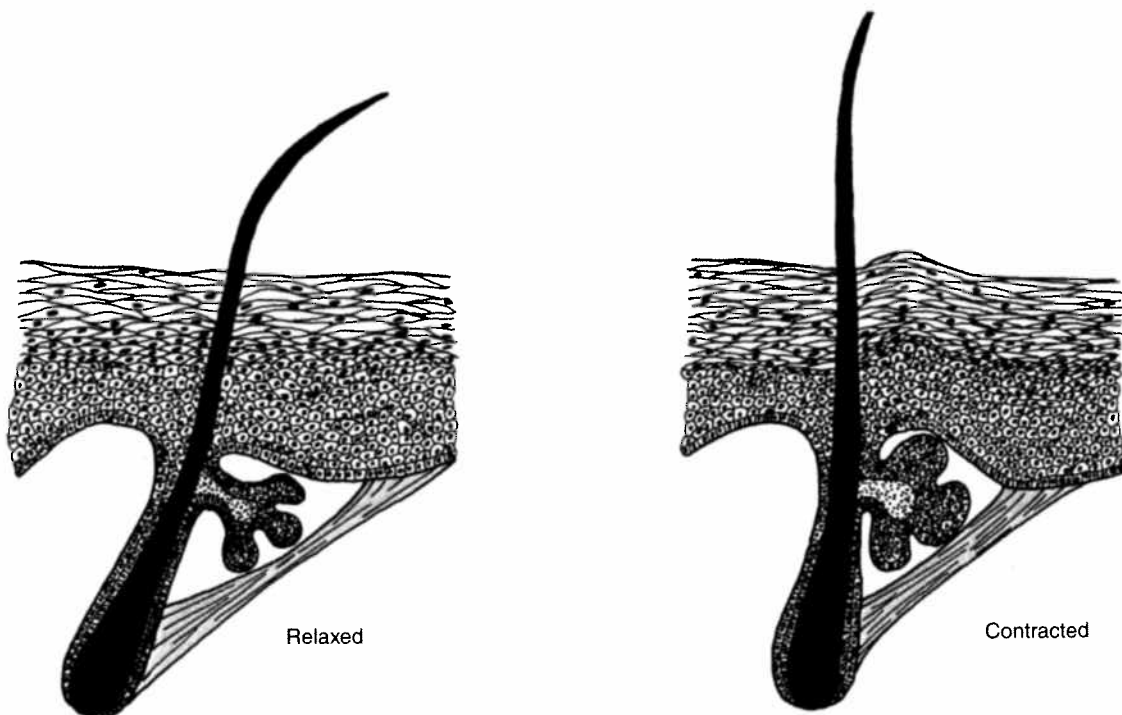


Figure 10-2 When the arrector pili contracts, it pulls the follicle and hair into a perpendicular position, improving the insulation quality of the hair. Notice how a "goose pimple" is raised around the follicle opening.

Answer
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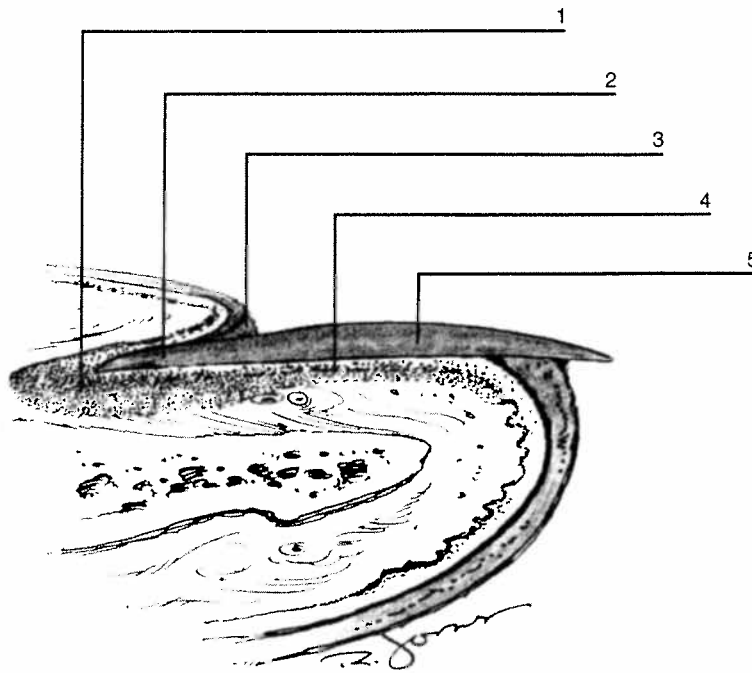


Figure 10-3 Label this section of a finger with the appropriate terms on the lines provided and on the blanks in the Lab Report at the end of this exercise.

Dissection: cat integument

If you are going to use the cat as a dissection specimen throughout this course, it must first be skinned. This exercise not only directs you on how to perform this essential step, it also provides an excellent opportunity to practice identifying surface anatomy—as well as to see “the big picture” of the integumentary system (Figure 10-4).

1 Examine the external aspect of your specimen (Figure 10-5):

- Determine the anatomical orientation of the specimen. Which direction is anterior? posterior? Which direction is ventral? dorsal? Identify sagittal, transverse, and frontal planes in your specimen.
- Identify these externally visible features:
 - Pinna (auricle, or external ear)
 - External nares (nostrils)
 - Vibrissae (whiskers)
 - Integument (skin)
 - Forelimbs
 - Hindlimbs
 - Thoracic region
 - Abdominal region
 - Genitals (sex organs)
 - Anus
 - Tail

- Determine the sex of your specimen by examining the external genitals (Figure 10-6):
 - Female**—Immediately anterior to the anus, on the ventral surface, is the **vulva** with an opening to the **vagina** and the **urethra**. The vulva is also called the **urogenital opening**.
 - Male**—In the male, there is a pouch of skin immediately ventral to the anus. This pouch—the **scrotum**—contains the **testes**, or male primary sex organs. Anterior to the scrotum is the end of the **penis** with its **prepuce**, or skinfold covering. Locate the opening of the **urethra** in the penis.

- 2 Place the animal in the tray with its ventral surface facing you. Insert the tip of a scissors into the hole already present under the chin. This hole was used to inject the cat's vessels with latex. If you are using a cat that was not injected, then lift up a fold of skin and puncture it at the same site. Slide the bottom tip of the scissors into the **subcutaneous** area under the skin.
- 3 Begin cutting along the lines indicated in Figure 10-5. Notice that you must cut all the way around the neck, and the distal ends of each limb (just proximal to the feet, or paws). All the other cuts are to be made only on the ventral aspect of the cat. When you make the median cut along the posterior abdomen, toward the tail, *cut around* the genitals rather than through them. Be careful not to cut into the skeletal muscles under the skin.

COLORING EXERCISE

Using colored pens or pencils, shade in the figure and accompanying labels in contrasting colors of your choice as indicated by the red numerals.

The Skin

Epidermis

- STRATUM CORNEUM 1
- STRATUM LUCIDUM 2
- STRATUM GRANULOSUM 3
- STRATUM SPINOSUM 4
- STRATUM BASALE 5

Dermis

- PAPILLARY LAYER 6
- RETICULAR LAYER 7
- SWEAT GLAND 8
- BLOOD VESSEL 9
- NERVE 10

Hair

- ROOT 11
- SHAFT 12
- FOLLICLE 13
- PAPILLA 14
- MATRIX 15
- ARRECTOR PILI 16
- SEBACEOUS GLAND 17
- HYPODERMIS 18

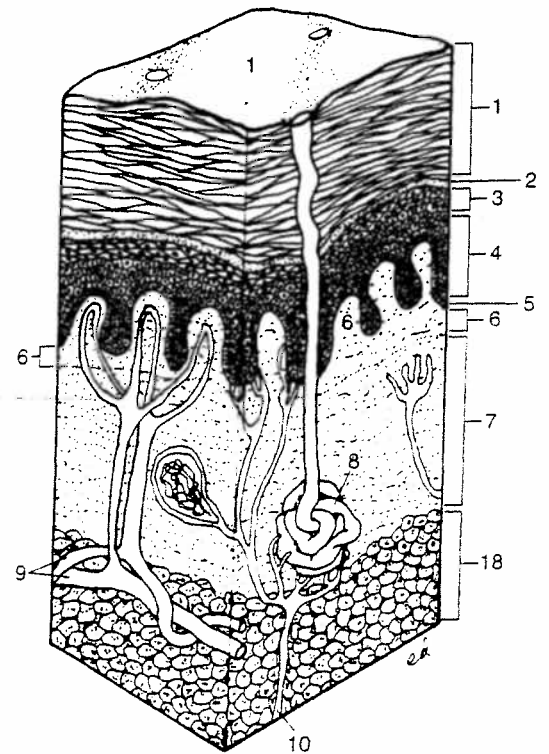
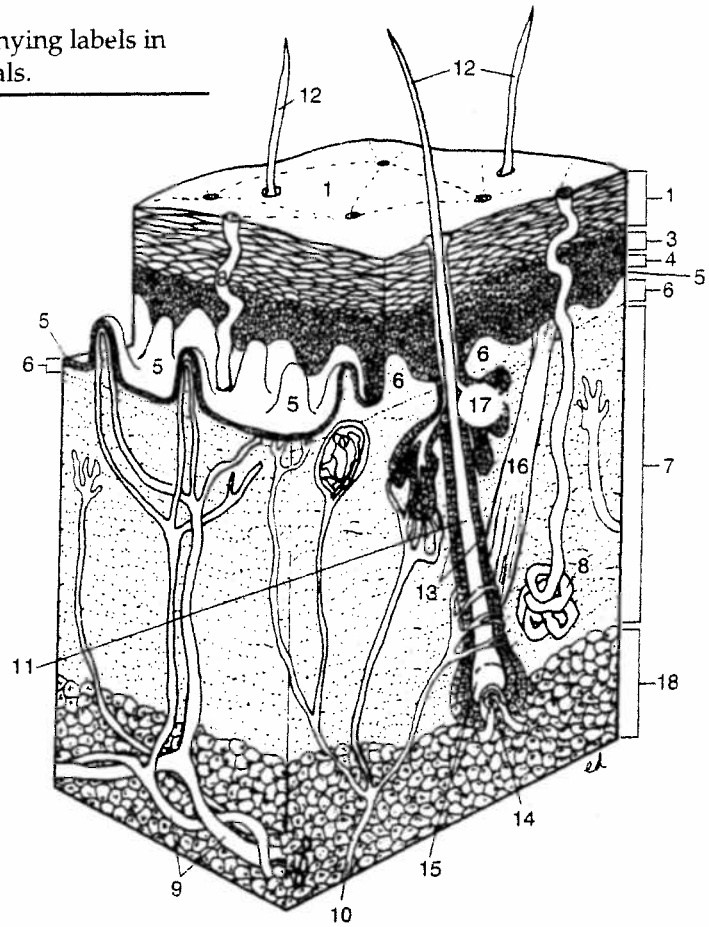


Figure 10-4 Structures of the skin. A, Thin skin. B, Thick skin.

Figure 10-3

1. _____
2. _____
3. _____
4. _____
5. _____

Fill-in

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

Fill-in (complete each item with the correct term)

1. The ___?___ is the superficial layer (of two) in the skin.
2. The hypodermis is mainly areolar and ___?___ tissue.
3. Fingerprint ridges are formed as a result of the orderly arrangement of dermal ___?___.
4. Stratum corneum is composed of dead cell parts and a tough, waterproof protein called ___?___.
5. Stratum ___?___ is the epidermal stratum in which one could find many phases of mitosis.
6. Cells are pushed into stratum ___?___ from stratum basale.
7. When you sense cold air around you, nerve endings in the ___?___ are probably involved.
8. When you sense cold air around you, bumps may appear on the skin. This is caused by the contraction of the ___?___.
9. The subcutaneous tissue is also called the superficial fascia, or ___?___.
10. Physiologists believe that some sweat glands produce aromatic, organic molecules called *pheromones*. The type of sweat gland (of the two discussed in this exercise) most likely to produce pheromones is ___?___.
11. Strong shampoo tends to remove ___?___ from the hair and scalp, making it dry and easily damaged.
12. The eponychium, or ___?___, covers part of the nail plate.
13. When you have your hair cut, the portion of the hair trimmed is called the ___?___.
14. Blood vessels that supply the epidermis are found in the ___?___ region of the dermis.
15. Stratum basale and stratum spinosum together may be called stratum ___?___.
16. Keratinized ___?___ epithelium forms the epidermis.
17. The dermis is composed mainly of ___?___ fibers, with a few elastic fibers.
18. Stratum ___?___ is usually absent in thin skin.
19. ___?___ glands produce sebum.
20. The most widely distributed type of sweat gland is the ___?___ type of gland.

Fill in the blank spaces in Table 10-1.

CHARACTERISTICS OF THE SKIN LAYERS		Table 10-1
Characteristic	Epidermis	Dermis
Tissue type		
Presence of blood vessels		
Relative thickness		
Permeability		
Relative strength		

Short Answer (write a few complete sentences)

How does thin skin differ from thick skin?