Integumentary System: skin glands, hair, and nails

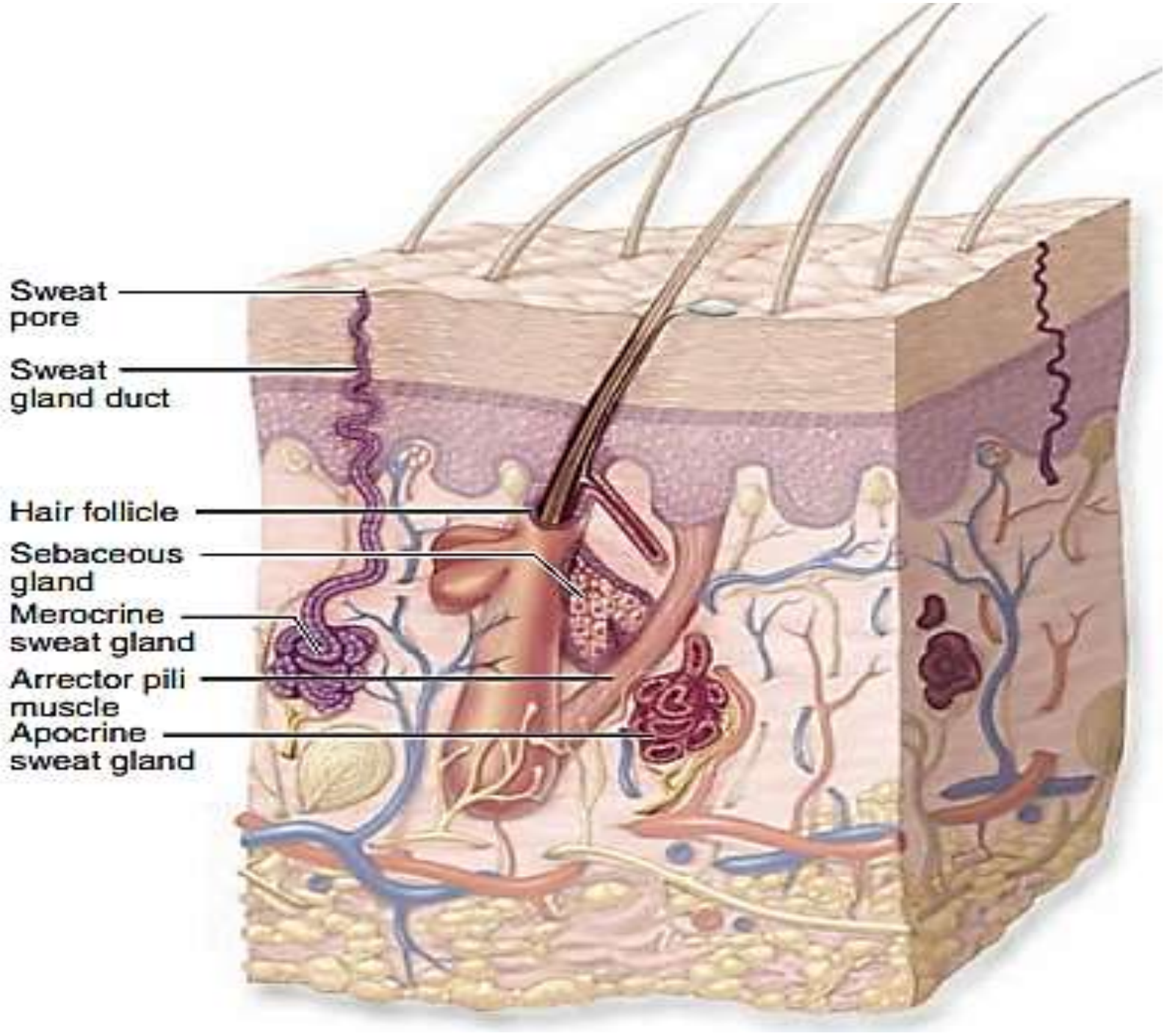
Lec. 9

Histology

Second year

Sebaceous Glands

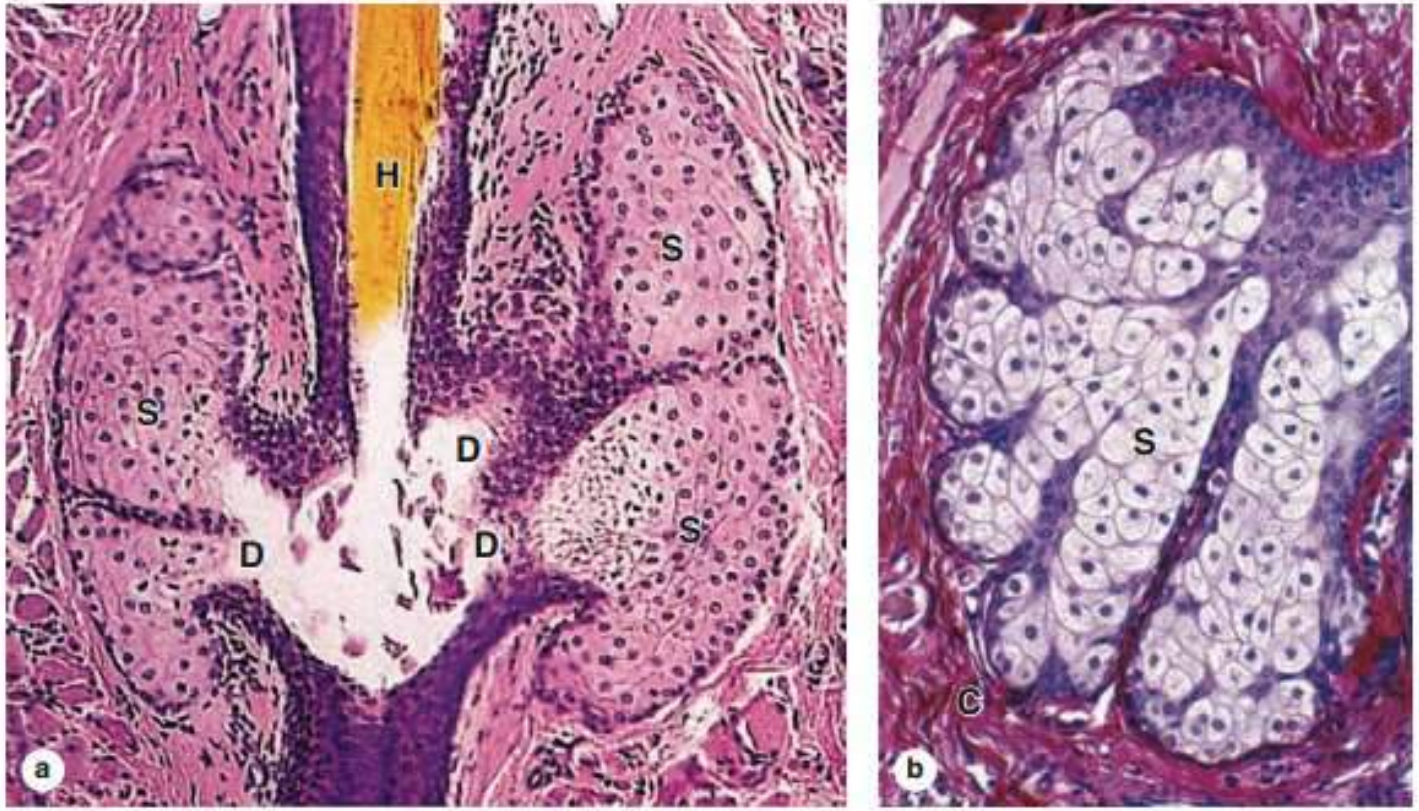
Sebaceous glands are embedded in the dermis over most of the body, except in the thick, glabrous skin of the palms and soles. There is increases to in the face and scalp. Sebaceous glands are **branched acinar glands** with several acini converging at a short duct that usually empties into the upper portion of a hair follicle. A hair follicle and its associated sebaceous glands make up a pilosebaceous unit. The stem cell niche of the follicle's bulge region also forms the progenitor cells of the associated sebaceous glands.


Sweat pore
Sweat gland duct
Hair follicle
Sebaceous gland
Merocrine sweat gland
Arrector pili muscle
Apocrine sweat gland

The acini of sebaceous glands are the classic example of **holocrine secretion**. They have a basal layer of flattened epithelial cells on the basal lamina, which proliferate and are displaced centrally, undergoing terminal differentiation as large, lipid-producing sebocytes filled with small fat droplets (Figure 18–17). Their nuclei shrink and undergo **autophagy** along with other organelles, and near the duct the cells disintegrate, releasing the **lipids** as the main secretory product. This product, called **sebum**, gradually covers the surfaces of both the epidermis and hair shafts.

Sebum is a complex mixture of lipids that includes wax esters, squalene, cholesterol, and triglycerides that are hydrolyzed by **bacterial enzymes after secretion**. Secretion from sebaceous glands increases greatly at **puberty**, **stimulated primarily by testosterone in men** and **by ovarian** and **adrenal androgens in women**. Sebum helps maintain the stratum corneum and hair shafts and exerts weak **antibacterial** and **antifungal** properties.

FIGURE 18–17 Sebaceous glands.



Sebaceous glands secrete a complex, oily mixture of lipids called **sebum** into short ducts that in most areas open into hair follicles. Sebum production is the classic example of holocrine secretion, in which the entire cell dies and contributes to the secretory product.

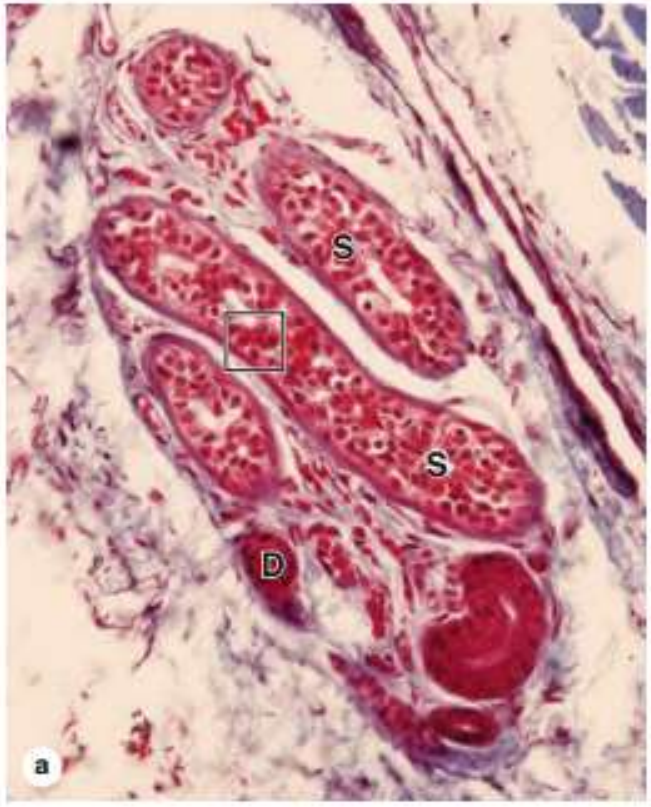
(a) A section of a pilosebaceous unit shows acini composed of large sebocytes (**S**), which undergo terminal differentiation by filling with small lipid droplets and then disintegrating near the ducts (**D**) opening at the hair (**H**). shaft (X122; H&E)

(b) A micrograph shows the gland's capsule (**C**) and differentiates sebocytes (**S**) at higher magnification. Proliferation of the small progenitor cells just inside the capsule continuously forces sebum into the ducts; myoepithelial cells are not present. (X400; H&E)

Sweat Glands

Sweat glands develop as long epidermal invaginations embedded in the dermis (Figure 18–1). There are two types of sweat glands, **eccrine** and **apocrine**, with distinct functions, distributions, and structural details. **Eccrine sweat glands** (Figures 18–16 and 18–18) are widely distributed in the skin and are most numerous on the foot soles. **Sweating** is a physiologic response to increased body temperature during **physical exercise** or **thermal stress** and is the most effective means of temperature regulation of humans. Both the secretory components and ducts of eccrine sweat glands are coiled and have small lumens.

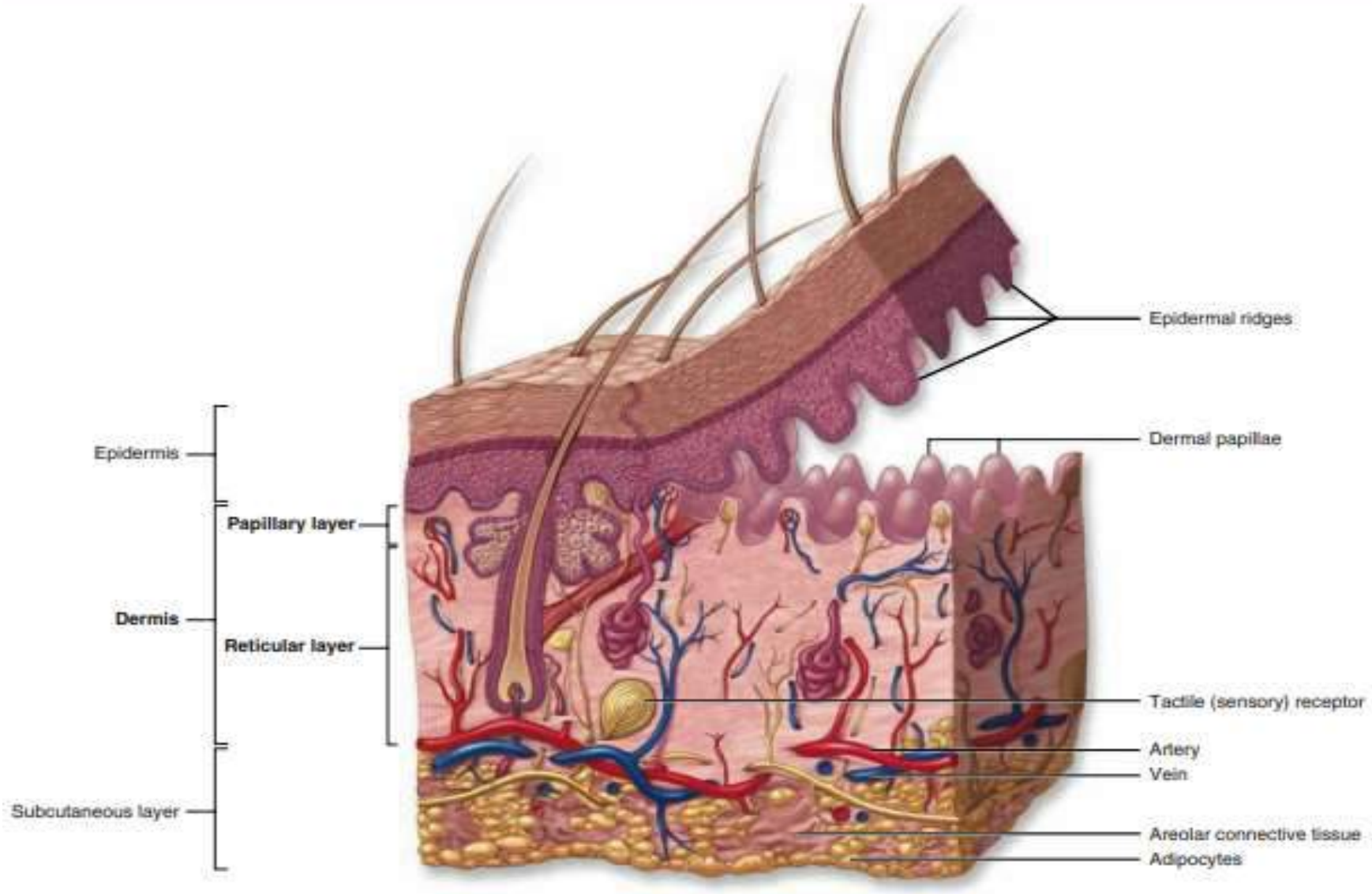
FIGURE **18–18** Eccrine sweat glands.



(a) Histologically eccrine glands have small lumens in the secretory components (**S**) and ducts (**D**), both of which have an irregular stratified cuboidal appearance. Both clear and acidophilic cells are seen in the stratified cuboidal epithelium of the secretory units. The box indicates an area with such cells like that shown ultrastructurally in part (b). (X200; Mallory trichrome)

(b) TEM of these important thermoregulatory structures reveals three cell types in their secretory portions. Myoepithelial cells (**M**) are present at the basal lamina (**BL**) to propel sweat into the

FIGURE **18–1** **Layers and appendages of skin.**



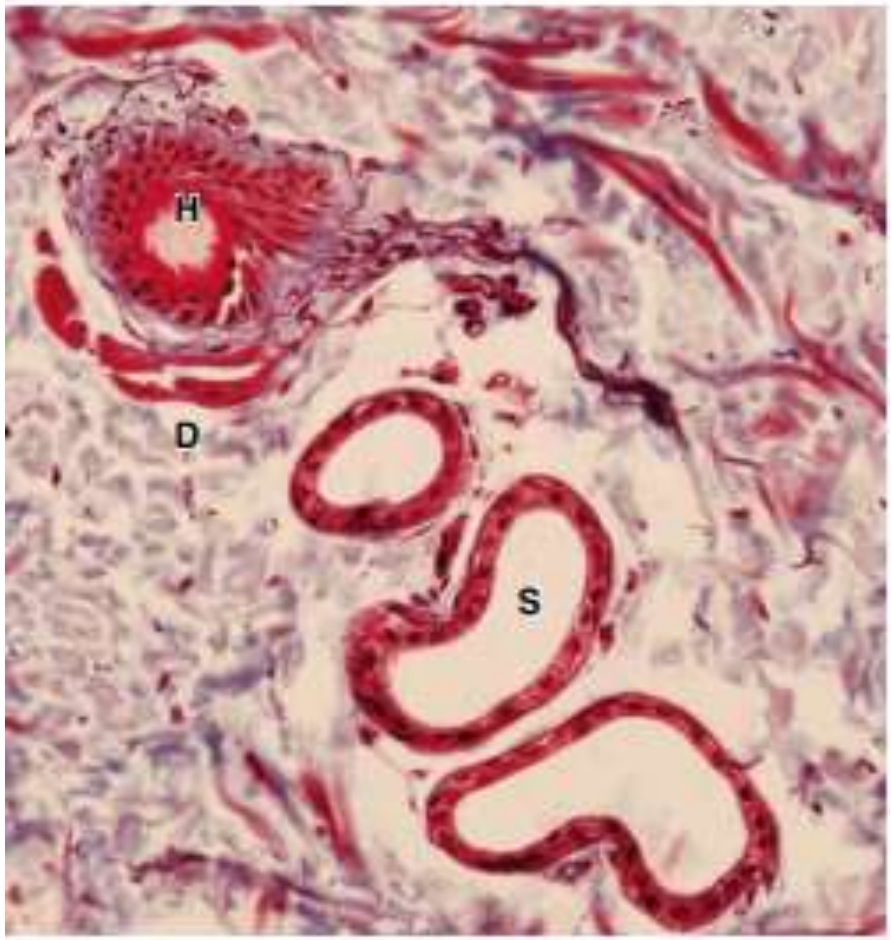
Diagrammatic overview of skin, showing the major layers and epidermal appendages (hair follicles, sweat, and sebaceous glands), the vasculature, and the major sensory receptors.

The secretory part is generally more pale-staining than the ducts and consists of an unusual **stratified cuboidal epithelium** with three cell types (Figure 18–18b):

1. **Pale-staining clear cells** located on the basal lamina produce the sweat, having abundant mitochondria and microvilli to provide large surface areas. Interstitial fluid from the capillary-rich dermis around the gland is transported through the clear cells, either directly into the gland's lumen or into intercellular canaliculi that open to the lumen.
2. **Dark cells** filled with strongly eosinophilic granules line most of the lumen and do not contact the basal lamina (Figure 18–18). The granules undergo merocrine secretion to release a poorly understood mixture of glycoproteins with bactericidal activity.
3. **Myoepithelial cells** on the basal lamina (Figure 18–18b) contract to move the watery secretion into the duct.

Apocrine sweat glands are largely confined to skin of the axillary and perineal regions. Their development depends on sex hormones and is not complete and functional until after puberty. The secretory components of apocrine glands have much larger lumens than the eccrine glands (Figure 18–19) and consist of **simple cuboidal**, eosinophilic cells with numerous secretory granules that also undergo exocytosis. The ducts of apocrine glands are usually open into hair follicles at the epidermis. The slightly viscous secretion is initially odorless but may acquire a distinctive odor as a result of bacterial activity. **Apocrine sweat glands** are innervated by **adrenergic nerve endings**, whereas **eccrine sweat glands** receive **cholinergic fibers.**

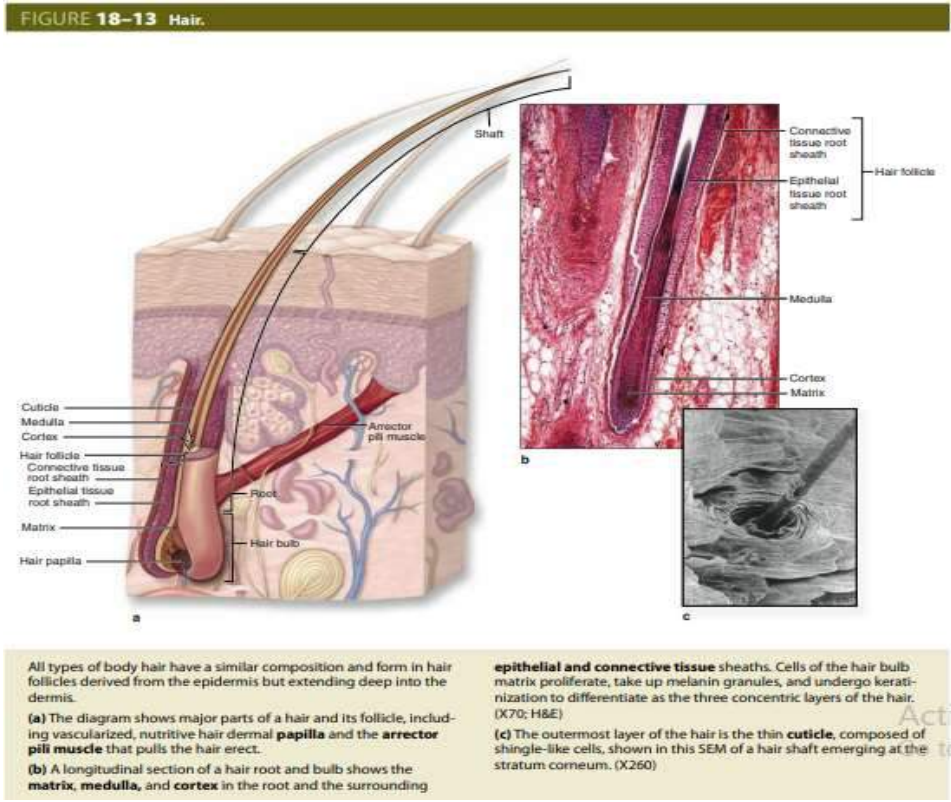
FIGURE 18–19 Apocrine sweat glands.



The secretory portions (**S**) of apocrine sweat glands have lumens that are much larger than those of eccrine sweat glands. The ducts (**D**) of apocrine glands also differ from those of eccrine glands in opening into hair follicles (**H**) rather than to the epidermal surface. (X200; Mallory trichrome)

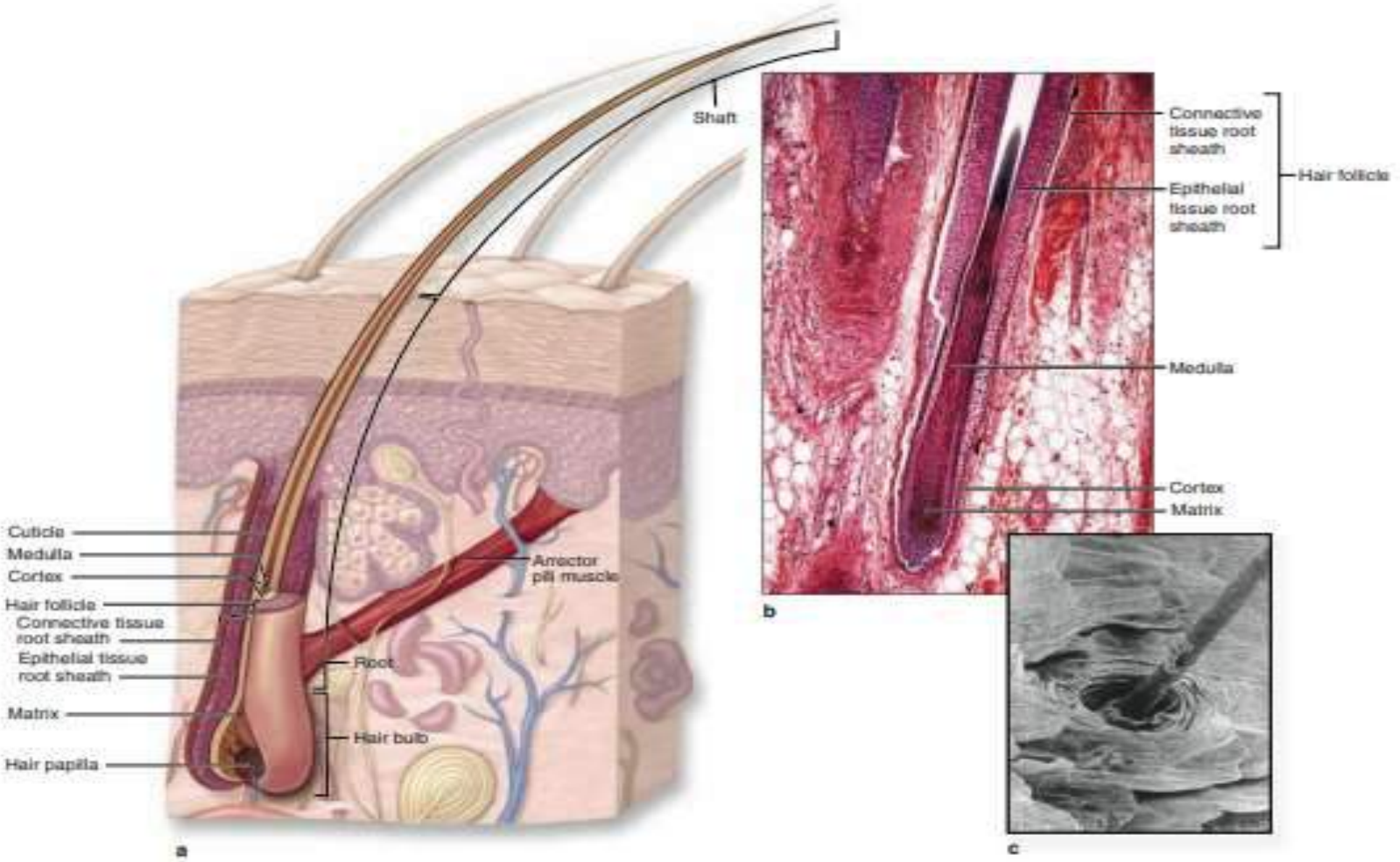
HAIR

Hairs are elongated keratinized structures that form within epidermal invaginations, the hair follicles (Figure 18–13). The color, size, shape, and texture of hairs vary according to age, genetic background, and region of the body. Hairs grow discontinuously, with periods of growth followed by periods of rest, and this growth does not occur synchronously in all regions of the body or even in the same area.



The growing hair follicle has a terminal dilation called a **hair bulb** (Figure 18–13a). A dermal papilla inserts into the base of the hair bulb and contains a capillary network required to sustain the hair follicle. Keratinocytes continuous with those of the basal epidermis cover the dermal papilla. These cells form the matrix of the elongating hair root; the part of a hair extending beyond the skin surface is the hair shaft. The keratinocytes of the hair bulb divide rapidly in the region immediately around the dermal papilla and then undergo keratinization, melanin accumulation, and terminal differentiation. Melanocytes in the hair bulb matrix transfer melanosomes into the epithelial cells that will later differentiate to form the hair. cells in the hair root matrix differentiate with variable amounts and types of keratin. The keratin of hair is harder and more compact maintaining its structure as the hair shaft much longer.

FIGURE **18–13** Hair.



All types of body hair have a similar composition and form in hair follicles derived from the epidermis but extending deep into the dermis.

(a) The diagram shows major parts of a hair and its follicle, including vascularized, nutritive hair dermal **papilla** and the **arrector pili muscle** that pulls the hair erect.

(b) A longitudinal section of a hair root and bulb shows the **matrix**, **medulla,** and **cortex** in the root and the surrounding **epithelial and connective tissue** sheaths. Cells of the hair bulb matrix proliferate, take up melanin granules, and undergo keratinization to differentiate as the three concentric layers of the hair. (X70; H&E)

(c) The outermost layer of the hair is the thin **cuticle**, composed of shingle-like cells, shown in this SEM of a hair shaft emerging at the stratum corneum. (X260)

The arrector pili muscle, a small bundle of smooth muscle cells, extends from the midpoint of the fibrous sheath to the dermal papillary layer (Figure 18–13a). Contraction of these muscles pulls the hair shafts to a more erect position, usually when it is cold in an effort to trap a layer of warm air near the skin. In regions where hair is fine, contraction of arrector pili muscles is seen to produce tiny bumps on the skin surface ("goose bumps") where each contracting muscle distorts the attached dermis. As mentioned earlier hairs grow asynchronously, cyclically, and at different rates in different regions of the body. The hair growth cycle has three major phases:

- A generally long period of mitotic activity and growth (**anagen**)
- A brief period of arrested growth and regression of the hair bulb (**catagen**)
- A final long period of inactivity (**telogen**) during which the hair may be shed

- At the beginning of the next anagen phase, epidermal stem cells located in small bulge of the external root sheath near the arrector pili muscle produce progenitor cells for the matrix of a new hair bulb. Hair growth on the face and pubis is strongly influenced by sex hormones, especially androgens, and begins at puberty

NAILS

A similar process of keratinization also produces the nails, which are hard plates of keratin on the dorsal surface of each **distal phalanx** (Figure 18–15). The proximal part of the nail is the nail root and is covered by a fold of skin, from which the epidermal stratum corneum extends as the **cuticle**, or **eponychium**. The nail plate is bound to a bed of epidermis, **the nail bed**, which contains only the basal and spinous epidermal layers. The **nail root** forms from the nail matrix in which cells divide, move distally, and become keratinized. The nail root matures and hardens as the nail plate (Figure 18–15). Continuous growth in the matrix pushes the nail plate forward over the nail at a rate of about 3 mm/mo for fingernails and 1 mm/mo for toenails. The distal end of the plate becomes free of the nail bed at the epidermal fold called the **hyponychium**. The nearly transparent nail plate and the thin epithelium of the nail bed provide a useful window on the amount of oxygen in the blood by showing the color of blood in the dermal vessels.

FIGURE **18–15** Nails.