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The Integument

1. Skin: *Epidermis and Dermis*
   *Hypodermis (a.k.a. superficial fascia)*

2. Appendages: *Specialization of epidermis*

   A. Pilosebaceous apparatus
      - *Hair*
      - *Sebaceous glands*
      - *Arrecto pili muscle*
   
   B. Sweat glands
      - *Eccrine sweat glands*
      - *Apocrine (odoriferous) sweat glands*

   C. Nail

   “Mammary gland”
The skin consists of epidermis and dermis and is the largest organ in the body, accounting for about 16% of the body weight.
Functions of skin

1. **Protection** (from abrasion, friction, infection, UV rays)
   - Keratin, melanin

2. **Permeability Barrier** (prevention of extreme water loss)
   - Keratin, lipid, sebum

3. **Thermoregulation**
   - Sweat glands, blood vessels, fat

4. **Sensory Perception**
   - Free and encapsulated nerve endings

5. **Immunologic Defense**
   - Keratinocytes, Langerhans cells

6. **Dermatoglyphics** (fingerprints)
Skin

Epidermis:
Keratinized, strat. sq. epithelium

Dermis:
Dense irregular ct.
Type III and
Type I collagen
Elastic fibers

Sweat Glands:
Eccrine and
Apocrine glands

Hypodermis (superficial fascia):
Fatty conn. Tissue
Cells of the Epidermis

- Keratinocytes (80%)
- Melanocytes (5-10%)
- Langerhans cells (5%)
- Merkel cells (<1%)
Cellular Layers of the Epidermis

Epidermis

Dermis

St. Condeum (keratin)
St. Lucidum
St. Granulosum (keratohyalin G, memb. coating G.)

St. Spinosum (desmosomes, tonofilaments)

Stratum Basale (St. germinativum) (mitosis)

"Keratinocytes"

Hemidesmosomes
Basal lamina

Transitional layer
Granular layer
Spinous layer
Cells of the Stratum Basale

- St. Sphinosum
- St. Basale
- Basement Membrane
- Dermis
- Basal Lamina
- Hemidesmosomes
- Tonofilaments
Stratum spinosum

Cells of the Stratum Spinosum

Source Undetermined
Blistering Skin Disorders

Pemphigus: *Separation of epidermal cells from each other* (acantholysis) *caused by loss of desmosome functions.*

Bullous pemphigoid: *Separation of epidermis from the dermis due to blistering in the basement membrane caused by loss of anchoring filaments and hemidesmosomes.*
Stratum Granulosum

Keratohyalin Granules (KG)

- Histidine-rich protein (*filaggrin*: filament aggregating protein that cross-links keratin)
- Polysaccharides and lipids

Membrane-coating granules (MCG)

(a.k.a. lamellar granules, Odland bodies)

- Primary intercellular lipid barrier to water - ceramide cross-links cell membranes.
Keratohyalin Granules

Weiss, L., Cell and Tissue Biology 6th ed. P. 549
Membrane Coating Granules

Primary intercellular barrier to water
Stratum corneum

15-20 layers of non-nucleated flattened cells filled with keratin filaments.

Keratin filaments are cross-linked with filaggrin.

The keratin-filaggrin deposited on the inside of the plasma membrane form a thickened cell envelope.
Thick and thin skin

Keratin

Blue arrows: Cells of the stratum granulosum

Source Undetermined
Melanocytes

Skin color

Red blood cells *in the dermal vascular beds.*

Carotenes *from exogenous foods stored in fatty tissues.*

Hemoglobin and bilirubin (*endogenous degradation products*).

Melanin (*pigment produced by melanocytes*)
Melanocytes
(neural crest origin)
Melanocytes produce Melanin

Melanin:
- Eumelanin
- Pheomelanin

Tyrosinase (deficiency: albinism)

Tyrosine $\rightarrow$ 3,4-dihydroxyphenylalanine (dopa)

$\rightarrow$ dopaquinone $\rightarrow$ Melanin
Epidermal-melanin unit

Cytocrine secretion
Melanosomes are responsible for skin pigmentation. The process involves:

1. **Melanosome formation**

2. **Melanosome melanization**

3. **Melanosome secretion**

4. **Melanosome degradation**

**Light skin** and **Dark skin** differ in the amount of melanin produced and retained by melanocytes.
Pigment distribution in light (left) and dark (right) skin
Merkel’s cell

Langerhans cell

Bone marrow derived

Bind, process and present antigen to T-lymphocytes

Role in immunologic skin reactions

Fawcett, Histology, pp. 536
Proliferation and Maturation of Epithelial Cells

Source Undetermined
Psoriasis
Dermis

Papillary Dermis
Reticular Dermis

Contains blood and lymphatic vessels, nerves, hair follicles, sebaceous glands, arrecto pili muscle, and sweat (eccrine and apocrine) glands

Hypodermis
(superficial fascia with fat cells)
Epithelial Pegs and Dermal Papillae
Papillary (PL) and Reticular (RL) Dermis

Type III Collagen

Elastic fibers (EF)

Type I Collagen
Papillary Dermis

houses blood vessels, nerve endings, etc.
Dermis and skin circulation

Wheater Fig. 9.18
Pilosebaceous apparatus

hair, sebaceous gland and arrecto pile muscle
**Hair follicle:** hair bulb and hair shaft

(A) Hair (B,C)
- Cuticle
- Cortex
- Medulla
- External root sheath
- Internal root sheath
- Connective tissue papilla
- Matrix

(B) Hair follicle cross-section
- Dermal papilla
- Hair matrix

(C) Source: Ross/Romrell, Histology 2nd ed. P. 361
(D) Source: Young/ Heath Wheater’s Histology 4th ed. P. 167
(E) Source: Undetermined
Growth Cycle of the Hair Follicle

Testosterone binds to intracellular receptors and inhibits the metabolism of condemned follicles. 5α-reductase converts testosterone to 5α dihydrotestosterone, which binds to intracellular receptors and inhibits the metabolism of condemned follicles.

Weiss, pg. 562
Pilo-sebaceous Apparatus
Mode of Secretion

**Merocrine** (Exocytosis)
Almost all exocrine glands, including eccrine and apocrine sweat glands.

**Apocrine** (some parts of cells are secreted)
Mammary glands (lipid secretion)

**Holocrine** (whole cells are secreted)
Sebaceous glands
Hair follicle and its associated structures

Tsaitgaist, Wikipedia
Eccrine Sweat Glands
Eccrine Sweat Gland

- Secretory portion
- Myoepithelial cells
- Ducts

Michigan Medical School Histology Slide Collection
Myoepithelial Cells

Myoepithelial cell

Glandular cells

Myoepithelial cell
Apocrine Sweat Glands
Apocrine Sweat Glands
Secretory Portions of Eccrine and Apocrine Sweat Glands
Histological Classification of Glands

1. Tubular
   - It is a tubular exocrine gland

2. Flask-like
   - It is an alveolar or acinar gland

3. Both
   - It is a tubulo-alveolar gland

If duct doesn't branch:

- It's a simple gland

If duct branches:

- It's a compound gland
Glandular Lobules and Lobes

Many *Lobules* form a *Lobe*.
Change in Mammary Gland Alveoli and Ducts

**Inactive:** No alveoli and undifferentiated terminal ducts.

**Active (during pregnancy):**

Proliferation and differentiation of alveoli.

**Active (lactating):** Secretion of milk and accumulation in alveolar lumen.
Inactive and active mammary glands

Inactive gland (left): Lobules are arranged sparsely and each lobule consists of mainly bluntly ending ducts with no secretory alveoli.

Active gland (right): Lobules are well developed and pack the gland. In each lobule, secretory alveoli have formed and their lumens are highly dilated.
The stroma of the mammary gland

The loose, more cellular and less fibrous, intralobular connective tissue makes the stroma distensible for the hypertrophy of the epithelial elements and differentiation of the alveoli. Numerous plasma cells (arrows above), which appear in the intralobular connective tissue during pregnancy and lactation, produce immunoglobulin IgA. IgA is taken up by the epithelial cells, secreted in the milk, and transported to the infant’s intestine where the antibodies resist bacterial infection.
The antibodies resist enteric infections.
Nipple - Lactiferous ducts

15-20 independent *lactiferous ducts*, each draining one of the lobes of the gland, open at the tip of the nipple. Within the nipple, each duct is slightly dilated to form a *lactiferous sinus* (inset).
The lactiferous duct is lined by a superficial layer of cuboidal epithelial cells and a basal layer of myoepithelial cells (arrows).
Learning Objectives

• Be able to identify principal layers of the skin (epidermis, dermis and hypodermis) at the light microscope level and know the major functions of each layer.
• Be able to identify the strata of the epidermis in thick and thin skin and know the major cellular events that take place in each layer in the process of keratinization.
• Be able to identify the cells in different layer of the epidermis at the electron microscope level by recognizing characteristic organelles and structures present in each layer.
• Be able to recognize melanocytes and know the process of pigment formation in the skin.
• Be able to identify eccrine and apocrine sweat glands at the light microscope level and distinguish ductal and secretory portions.
• Be able to identify the components of the pilosebacious apparatus and know the structural relationship between each component and the epidermis.
• Be able to identify the mammary gland, by recognizing its structural components (lactiferous ducts, alveoli, lobules, the stromal connective tissue), and know the histological differences in active and inactive glands.
Additional Source Information
for more information see: http://open.umich.edu/wiki/CitationPolicy

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Slide 7: Michigan Medical School Histology Slide Collection
Slide 8: Michigan Medical School Histology Slide Collection
Slide 9: Michigan Medical School Histology Slide Collection; Source Undetermined
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