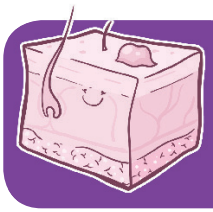

NOTES
SKIN STRUCTURES

SKIN ANATOMY & PHYSIOLOGY

osms.it/skin-anatomy-and-physiology

- Skin is body's largest organ
  - Seven percent of total body weight
- Comprises integumentary system, appendages (hair, nails, oil, sweat glands)
  - Protects body (infection, abrasion, dehydration, etc)
  - Regulates body temperature
  - Detects pain, sensation, pressure
  - Essential for vitamin D production
- Three layer division
  - Epidermis, dermis, hypodermis

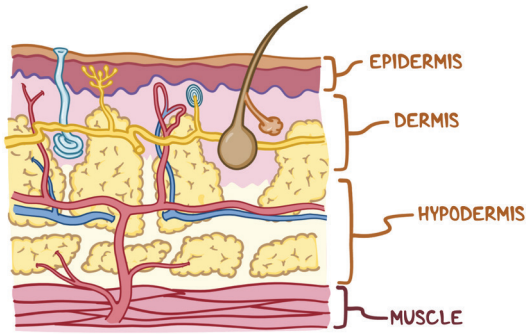

Figure 25.1 The three layers of the skin, from superficial to deep, include: the epidermis, dermis, and hypodermis.

EPIDERMIS

- Epidermis
  - Stratified squamous epithelium
  - Thin outermost layer
- Multiple layers of developing keratinocytes (contain keratin)
  - Make, secrete glycolipids; prevent water seeping into/out of body

Stratum basale

- *Innermost layer:* single columnar stem cell layer; dividing, producing keratinocytes
  - Keratinocytes contain cholesterol precursors activated by UVB light → vitamin D (regulates calcium absorption)
- Also contains melanocytes (secrete melanin, giving skin its color)
  - UVB light stimulates melanin secretion → placed into melanosomes, moved up by keratinocytes → scatters UVB light → natural sunscreen (prevents skin cancer from excessive UVB light)

Stratum spinosum

- *Second layer:* comprises 8–10 keratinocyte cell layers which can no longer divide
  - Proteins on keratinocytes help them adhere together
  - Dendritic cells seek out invading microbes

Stratum granulosum

- *Third layer:* comprises 3–5 keratinocyte cell layers undergoing keratinization (flatten out, die) → epidermal skin barrier formed
  - Keratohyalin granules in keratinocytes contain keratin precursors which aggregate, cross-link → keratin bundles
  - Lamellar granules in keratinocytes contain glycolipids (secreted to cell surface, glues cells together)

Stratum lucidum

- *Fourth layer:* comprises 2–3 dead keratinocyte cell layers that have secreted most of their lamellar granules
  - Only found in thick skin (e.g. palms, soles of feet)

Stratum corneum

- *Uppermost layer:* comprises 20–30 dead keratinocyte cell layers glued together with glycolipids
  - Dead keratinocytes secrete defensins to fight pathogens
  - Cells from stratum lucidum push up → cells from this layer shed → skin flakes/dandruff

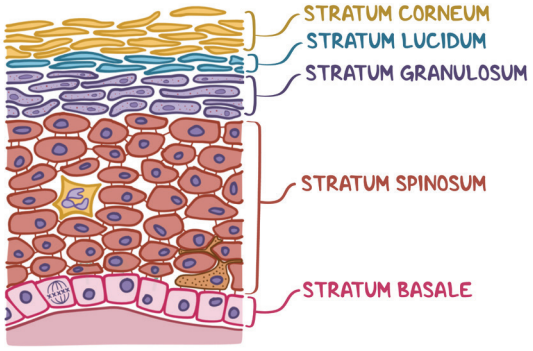

Figure 25.2 The five layers of the epidermis. Stratum basale is the deepest layer and stratum corneum is the most superficial.

DERMIS

- Dermis
  - Central layer
  - Two layer division (papillary layer; deeper, thicker reticular layer)

Papillary layer

- Fibroblasts (producing collagen) arranged in papillae
- Contains blood vessels, macrophages, nerve endings (e.g. Meissner's corpuscles for fine touch, free nerve endings for pain)
- Responsible for fingerprints (↑ gripping, sensing abilities)

Reticular layer

- Fibroblasts (produces elastin for flexibility)
- Contains oil, sweat glands; lymphatic, blood vessels; hair follicles; macrophages; nerves (e.g. Pacinian corpuscle for pressure, vibration)
- Collagen packed tightly → ↑ support
- Regulates temperature with blood vessels, sweat glands
  - Blood vessels dilate when hot (blood moves closer to surface → allows heat loss)/contract when cold (blood moves away from surface → prevents heat loss)
  - Sweat glands ↑ secretion when hot (↑ heat to evaporate sweat)/↓ when cold (↓ heat to evaporate sweat)

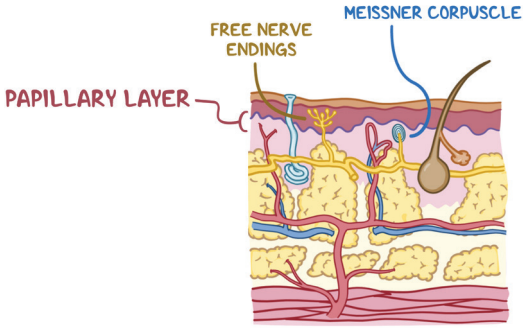

Figure 25.3 The papillary layer of the dermis contains multiple types of nerve endings.

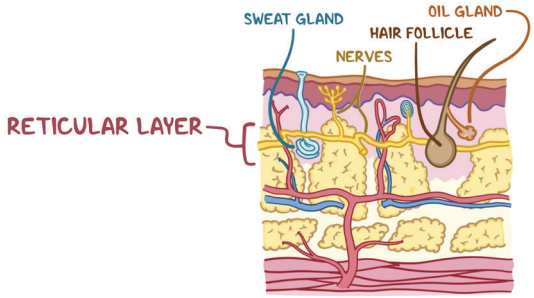

Figure 25.4 Contents of the reticular layer of the dermis.

HYPODERMIS

- Hypodermis (subcutaneous tissue) inner layer
  - Contains adipocytes (store fat), fibroblasts, macrophages, blood vessels, nerves, lymphatics
  - Insulates deeper tissues; provides padding; anchors skin to underlying muscle with connective tissue (e.g. collagen)

HAIR, SKIN, & NAILS

osms.it/hair-skin-and-nails

- Skin appendages include hair, nails, skin glands (oil/sebaceous, sweat/sudoriferous)
  - Regulate body temperature; environmental protection
  - Originate in dermis
- Hair, nails comprised of long, filamentous protein (keratin)
  - *Keratin:* produced by keratinocytes during keratinization (cells rapidly replicate, die)
  - Soft keratin (produced by skin); hard keratin (produced by hair, nails)

HAIR

- Includes vellus hairs (short, thin); terminal hairs (more visible, growth starts at puberty)
- Found everywhere
  - *Exceptions:* palms, soles of feet, lips
- Hair strands sit in follicle; epidermal tissue dips into dermis
  - Associated with sebaceous glands, arrector pili muscles, apocrine glands, nerve receptors
- *Composition:* shaft, root, bulb
  - *Hair matrix:* active hair growth site, found inside bulb; contains keratinocytes, melanocytes; blood supplied by papilla
- Keratinocytes die, flatten out → hard keratin fills up cell → gradually get pushed up follicle forming hair
  - *Hair growth:* includes growth, resting phases
  - Keratinocytes in bulb replicate set number of times → follicle eventually stops producing hair/produce vellus hairs instead (genetically determined) → baldness
- Melanocytes produce melanin (protein pigments that give hair color)
  - Melanocytes move melanin into melanosomes → taken up by keratinocytes

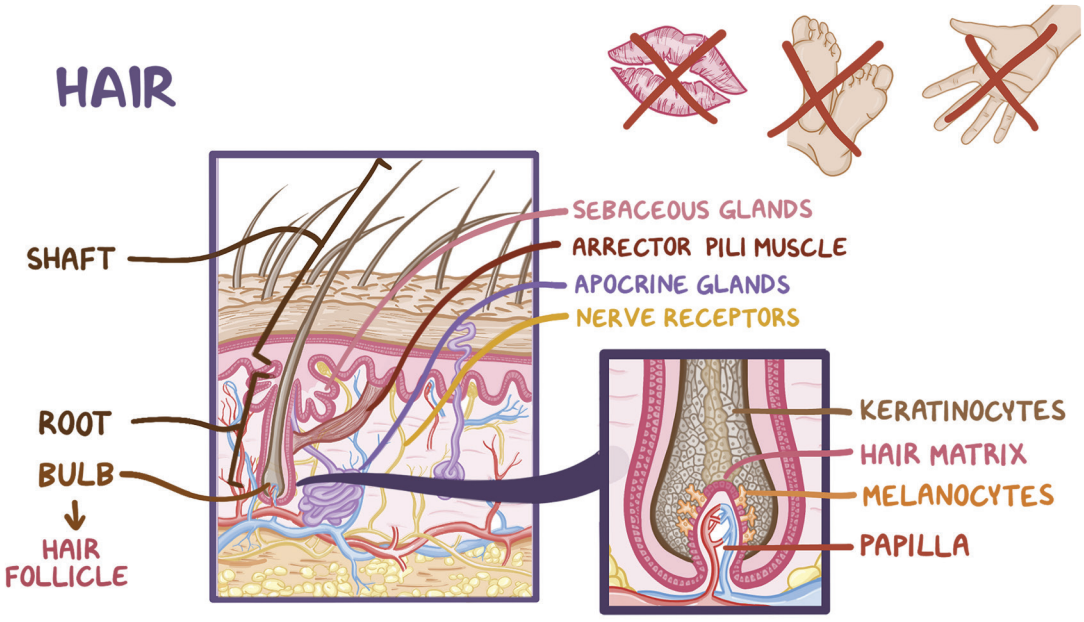

Figure 25.5 Composition of hair and associated structures.

- ↑ age → ↓ melanin → faded, white hair
- Nerve receptors around bulb stimulated when hair shaft moves
- Arrector pili muscle contracts, pulls hair (e.g. cold weather/frightened) → goosebumps

NAILS

- Grow from proximal to distal fingertips/toes
  - Surrounded on either side by nail folds
  - Closed off proximally by eponychium → forms cuticle (dead skin keratinocytes that cover junction between nail, skin)
- *Nail matrix composition:* lunula, nail plate
  - *Lunula:* white, crescent-shaped part of nail near eponychium
  - *Free edge:* nail plate portion hanging over skin
- Modified keratinocytes in matrix form plate by keratinization (similar to hair)
- Nails grow continually through life (unlike hair)

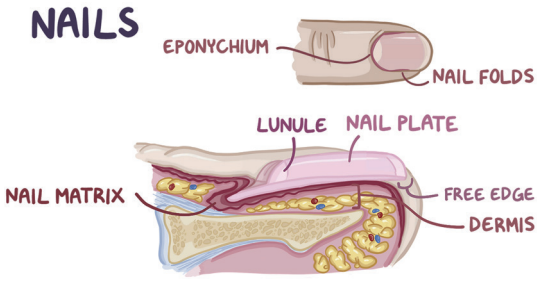

Figure 25.6 Superior view and cross section of a finger illustrating components of the nail.

SEBACEOUS GLANDS

- Secrete sebum (softens hair shaft, prevents moisture-loss, deters pathogens) onto hair follicles/through pores → skin surface
- *During puberty:* ↑ androgen hormones → ↑ sebum production → blocks pores, plugs hair follicles → enclosures allow infection development (e.g. acne, folliculitis)

SUDORIFEROUS GLANDS

- AKA sweat glands

Eccrine (merocrine) glands

- Found everywhere
  - *Exceptions:* lips, ear canal, clitoris, glans of penis
- Coil-shaped structure; in dermis; duct opens into pore on skin surface
- *Sweat:* hypotonic (mostly water, electrolytes); dermcidin (destroys bacteria); cools body (evaporation)
- Sympathetic nervous system activation during ↑ cardiovascular activity, fight-or-flight response, fear/anxiety

Apocrine glands

- Found in armpits, genitals
  - Become active during puberty
- Similar to eccrine glands
  - Bigger, fewer; produce secretions with ↑ lipids, proteins
  - Secretions metabolized by bacteria → body odor
- Several modified apocrine gland types
  - *Ceruminous glands:* in ear; produce cerumen; protects eardrum (with ear canal hairs)
  - *Mammary glands:* in breasts; produce milk

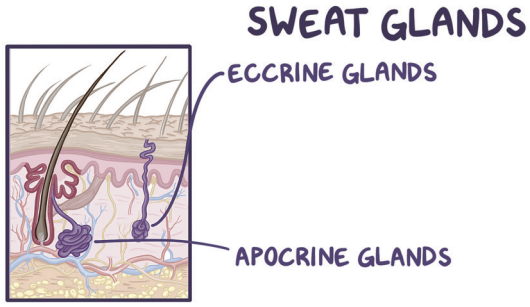

Figure 25.7 The two types of sweat glands (sudoriferous glands).

WOUND HEALING

osms.it/wound-healing

- Damaged tissue repair process
  - Acute wounds heal quickly (days–weeks)
  - Chronic wounds heal slowly (months)

Regenerative tissue capacity

- *Classification:* labile, stable, permanent
- Labile tissues (e.g. skin, connective tissue, intestines)
  - *Heal well:* stem cells constantly divide → rapid, effective healing
- Stable tissues (e.g. liver, endocrine glands, proximal kidney tubules)
  - *Heal slowly:* mature differentiated cells divide/regenerate by hyperplasia
- Permanent tissues (e.g. skeletal muscle, cartilage, neurons)
  - *Heal poorly:* lack of stem cells, no hyperplasia → replaced by scar tissue (fibrosis) → function loss

Open wounds

- Open wounds healed by primary, secondary, tertiary intention
- Primary intention (most surgical wounds)
  - Wound edges fuse (e.g. stitching/gluing) → stem cells (e.g. epidermis) approximate, regenerate damaged tissue (minimal scarring)
- Secondary intention
  - Wound edges too far apart (e.g. pressure ulcers, tooth extraction, severe burns) → stem cells do not approximate → wound replaced by connective tissue growing from base upwards (slower healing; more scar tissue)
- Tertiary intention (delayed closure)
  - Wound cleaned, debrided → purposefully left open (↓ bacterial contamination likelihood) → closed by primary intention/left open for secondary intention

Penetrating trauma wound healing

- Penetrating trauma wound healing steps (e.g. cutting finger → damaged epidermis, dermis, interstitial space)
- Hemostasis (first step)
  - Blood vessels constrict → platelets adhere to site → forms platelet plug → fibrin mesh reinforces platelet plug → forms blood clot
- Inflammation (second step)
  - Damaged cells release chemokines, cytokines → neutrophils, macrophages recruited; blood vessels dilate → immune cells clear debris, digest dead/damaged cells, destroy microbes → blood clot, dead macrophages combine, form scab
- Epithelization/migration (third step)
  - Basal cells (epidermal stem cells) proliferate, replace lost/damaged cells → rejuvenated epidermal layer (approx. 48 hours)
- Fibroplasia (fourth step)
  - Fibroblasts in dermis proliferate, secrete collagen (assemble → form collagen fibrils → collaged bundles) → blood vessel growth stimulated (angiogenesis); fibroblasts also produce glycoproteins, sugars → create granulation tissue in dermal layer
- Maturation (fifth step)
  - *Collagen cross-linking:* covalent bonds form between collagen bundles, improving tensile strength
  - *Collagen remodeling:* fibroblasts degrade subpar collagen
  - *Contraction:* myofibroblasts produce contractile proteins, pulling wound's edges together
  - *Repigmentation:* melanocytes proliferating, restoring color to damaged skin

Chronic wounds

- Healing prevention factors → chronic wounds
  - *Narrowed capillaries:* prolonged compression/disease (e.g. diabetes, atherosclerosis) → ↓ blood flow → damaged tissue cannot be reached by immune cells, insufficient oxygen/nutrients → tissue necrosis
  - *Infection:* pathogens compete for oxygen; cause ongoing damage, inflammation
  - *Edema:* disrupts fibroblast activity, collagen deposition, collage cross linking

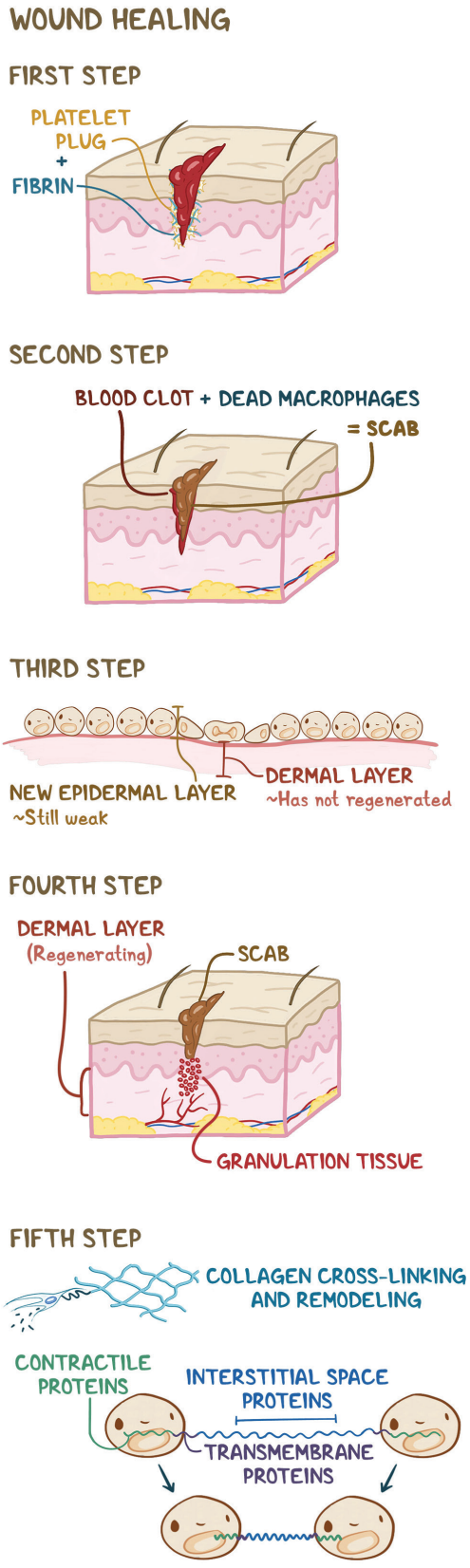

Figure 25.8 The five steps of penetrating trauma wound healing.