INTEGUMENTARY SYSTEM
PART I: FUNCTIONS & EPIDERMIS

Integumentary System
Cutaneous membrane
- Epidermis (5-layers)
  - made up of epithelial tissue only
- Dermis (2-layers)
  - contains connective tissue, vessels, etc.
Subcutaneous layer
- Hypodermis (1-layer)
  - loose connective tissue, mostly adipose

Functions of Skin
- Protection
  - Abrasion
  - Dehydration
  - Immunity
  - UV blocking
- Temperature Regulation
- Sensation
- Excretion
- Vitamin D Synthesis

Vitamin D
- Epidermal cells produce cholecalciferol (vitamin D₃):
  - in the presence of UV radiation
- Liver and kidneys convert vitamin D into calcitriol:
  - to aid absorption of calcium and phosphorus in the gut
**What are the main structures and functions of the epidermis?**

**Epidermis**
- Avascular stratified squamous epithelium
- Majority of cells are called ‘keratinocytes’:
  - produce keratin
  - used for protection and durability, elasticity, and waterproofing
- Pigment-producing cells called ‘melanocytes’:

**Function of Melanocytes**
- Produce melanin
  - yellow-brown or black pigment
  - protects skin from sun damage
  - Melanin is transferred to keratinocytes
- Ultraviolet (UV) radiation:
  - causes DNA mutations, connective tissue damage which lead to cancer and wrinkles
- ALL people have the SAME number of melanocytes
  - ...even albinos

**Layers of the Epidermis**
- From basal lamina to free surface:
  - stratum germinativum (basale)
  - stratum spinosum
  - stratum granulosum
  - stratum lucidum
  - stratum corneum
Stratum Germinativum (Basale)
- The “germinative layer”:
  - is attached to basal lamina
- Specialized cells
  - Merkel cells & melanocytes

Connection between dermis and Stratum Germinativum
- Epidermal ridges (e.g., fingerprints)
- Dermal papillae (tiny mounds):
  - strengthen attachment between epidermis and dermis

Stratum Spinosum
- The “spiny layer”:
  - produce keratin
- Specialized cells
  - Langerhans cells - immune system defense

Stratum Granulosum
- The “grainy layer”
  - Keratinocytes die
  - Epidermis becomes ‘waterproof’ here

Stratum Lucidum
- The “clear layer”:
  - found only in thick skin
  - (this is what your book says. Not true, this layer is everywhere, it is just thinner in other parts, unless abrasion occurs then it thickens.)

Stratum Corneum
- The “horn layer”:
  - exposed surface of skin
  - shed and replaced every 2 weeks
  - cells constantly flake off
    - feeds the dust mites in your mattress!

Functions of the Epidermis
- The epidermis:
  - is a multilayered, flexible, self-repairing barrier
  - prevents fluid loss
  - protects from UV radiation
  - produces vitamin D₃
  - resists abrasion, chemicals, and pathogens
PART II: DERMIS

What are the structures and functions of the dermis?

The Dermis
• Is located between epidermis and subcutaneous layer
• Anchors epidermal accessory structures (hair follicles, sweat glands)
• Has 2 layers:
  - outer papillary layer
  - deep reticular layer

Characteristics of Dermis
Dense Irregular Connective Tissue
• Strong, due to collagen fibers
• Elastic, due to elastic fibers
• Flexible (skin turgor)

Layers of the Dermis
• Papillary Layer
  - Consists of areolar tissue (not really)
  - Provides nutrients to epidermis
  - Contains sensory neurons
  - Has dermal papillae projecting between epidermal ridges
• Reticular Layer
  - Consists of dense irregular connective tissue
  - Contains larger blood vessels, lymph vessels, and nerve fibers
  - Contains collagen and elastic fibers

Nervous Activity in Skin
• Blood flow (e.g. hot/cold/embarrassed)
• Gland secretions (e.g. stress)
• Sensory receptors:
  - Thermoreceptors - hot & cold
  - Free nerve endings - pain, itch, tickling, etc...
  - Root hair plexus
  - Merkel cells - fine touch
  - Meissner’s corpuscles - touch & vibration
  - Pacinian corpuscles - deep pressure
  - Ruffini corpuscles - skin distortion, movement

The Subcutaneous Layer
• Subcutaneous layer = Superficial fascia = Hypodermis
  - Loose connective tissue
  - Below the dermis
  - Location of hypodermic injections
INTEGUMENTARY SYSTEM
PART III: ACCESSORY STRUCTURES

Integumentary Accessory Structures
• Hair, hair follicles, sebaceous glands, sweat glands, and nails:
  - are made of epithelial tissue (part of epidermis)
  - are located in dermis
  - project through the skin surface

The Hair Follicle
• Is located deep in dermis
  - (made of epithelial tissue)
• Produces nonliving hairs
  - (made of a tougher keratin than in epidermis)

How Hair Grows
• Hair begins deep in the dermis, an extension of stratum germinativum (basale) with melanocytes:
  - the hair papilla contains capillaries and nerves (root hair plexus)
• As hair is produced in the bulb, it is keratinized:

Accessory Structures of Hair
• Arrector pili:
  - involuntary smooth muscle
  - causes hairs to stand up
  - produces “goose bumps”
• Sebaceous glands:
  - control bacteria
  - produce sebum (oil)

Structures of Nails
• Nail body:
  - the visible portion of the nail
  - covers the nail bed
• Lunula:
  - Pale crescent at the base of the nail
What are the skin glands and secretions?

Exocrine Glands
• Sebaceous glands (oil glands):
  - Holocrine glands

Sebaceous glands
• Sebaceous glands (oil glands):
  - sebum is acidic
  - Secretions are stimulated by hormones

• Sudoriferous glands (sweat glands):
  - Merocrine (eccrine)
  - Apocrine
Sudoriferous Apocrine Glands
• Found in armpits, around nipples, and groin
• Associated with hair follicles
• Produce sticky, cloudy secretions
  - pheromones
• Break down and cause odors
  - Musky odors
  - B.O. is made by bacteria

Sudoriferous Merocrine Glands
• Widely distributed on body surface
  - especially on palms and soles
  - watery secretions
• Also called sudoriferous eccrine glands:
  - coiled, tubular glands
  - discharge directly onto skin surface
  - sensible perspiration
  - water (99%), salts (electrolytes), and organic compounds

Other Integumentary Glands
• Mammary glands:
  - produce milk
• Ceruminous glands:
  - protect the eardrum
  - produce cerumen (earwax)
INTEGUMENTARY SYSTEM
PART IV: SKIN REPAIR & BURNS

Repair of Localized Injuries to the Skin

Step 1
- Bleeding occurs
- (white blood cells, Mast cells trigger inflammatory response)

Step 2
- Scab stabilizes, protects the area

Step 2: The Inflammatory Response
- Germinative cells migrate around the wound
- Macrophages clean the area
- Fibroblasts and endothelial cells produce granulation tissue

Step 3
- Fibroblasts produce collagen fibers for strength across wound = scar tissue
- Inflammation decreases, clot disintegrates

Tissue Repair
- Injury causes inflammation & immune response
  - 1. white blood cells & clotting proteins enter
  - 2a. clot forms, debris removed
  - 2b. granulation
  - 3a. collagen formed
  - 3b. surface epithelium regenerates
Burns

- Disrupt body homeostasis
  - local and systemic effects
    - first concern: dehydration & shock
    - decreased circulation & urine production
    - second concern: bacterial infection
  - Depth is rated by degree
    - 1st, 2nd, 3rd, 4th
  - Surface area is rated by percentage
    - Rule of Nines

1st Degree Burn
- Epidermal layer: Sunburn
- Local damage: redness, pain, swelling
- Surface layer shedding after few days
  - (desquamation)
- Minimal or moderate edema
  - no need for IV

2nd Degree Burn
- Epidermis and dermis
- Blisters
- Moderate to severe pain
- Recovery slow but complete if no infection
- 7-10 days to heal

3rd Degree Burn
- Entire thickness of skin and underlying tissue
- Charred and insensitive to touch
- Wounds develop
- Heals with scar tissue
- 4th Degree extends to muscle, joint, bone
  - similar to a severe crush: amputation

Rule of Nines
- To estimate burn damage, surface area is divided into multiples of 9

![Rule of Nines Diagram](image)