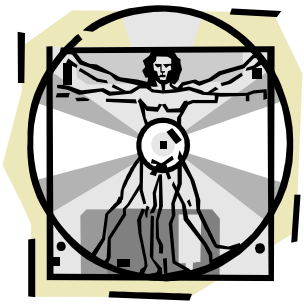
Bio& 241
Unit 1 / Lecture 5



Glandular Epithelium

- ***Gland:***
  - a single cell or a mass of epithelial cells adapted for secretion
  - derived from epithelial cells that sank below the surface during development

- ***Endocrine glands*** are ductless. They secrete their products into ducts that empty at the surface of covering and lining epithelium or directly onto a free surface .

Glandular Epithelium

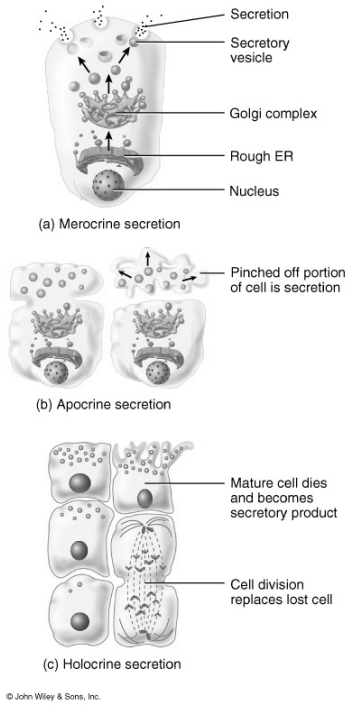
- ***Exocrine glands***
  - cells that secrete---sweat, ear wax, saliva, digestive enzymes onto free surface of epithelial layer
  - connected to the surface by tubes (ducts)
  - unicellular glands or multicellular glands
- ***Endocrine glands***
  - secrete hormones into the bloodstream
  - hormones help maintain homeostasis

Mechanisms for Glandular Secretion

Merocrine Glands:
- Salivary glands
- Sudoriferous sweat glands of the skin

Apocrine Glands:
- Lactiferous tissue of the Mammary glands
- Apocrine sweat glands

Holocrine Glands:
- Sebaceous (oil) glands of the skin



Introduction to the Integumentary System

- The skin and its accessory structures make up the integumentary system.
- The integumentary system functions to guard the body's physical and biochemical integrity, maintain a constant body temperature, and provide sensory information about the surrounding environment**.**

A large organ composed of all 4 tissue types 22 square feet 1-2 mm thick Weight 10 lbs.

TYPES OF SKIN

- ***Thin skin***
  - covers all parts of the body except for the palms and palmar surfaces of the digits and toes.
  - lacks epidermal ridges
  - has a sparser distribution of sensory receptors than thick skin.
- ***Thick skin*** (0.6 to 4.5 mm)
  - covers the palms, palmar surfaces of the digits, and soles
  - features a stratum lucidum and thick epidermal ridges
  - lacks hair follicles, arrector pili muscles, and sebaceous glands, and has more sweat glands than thin skin.

FUNCTIONS OF SKIN

- ***Thermoregulation***
  - Perspiration & its evaporation
  - lowers body temperature
  - flow of blood in the dermis is adjusted
- ***Shivering*** and constriction of surface vessels
  - raise internal body temperature as needed
- ***Exercise***
  - in moderate exercise, more blood brought to surface helps lower temperature
  - with extreme exercise, blood is shunted to muscles and body temperature rises

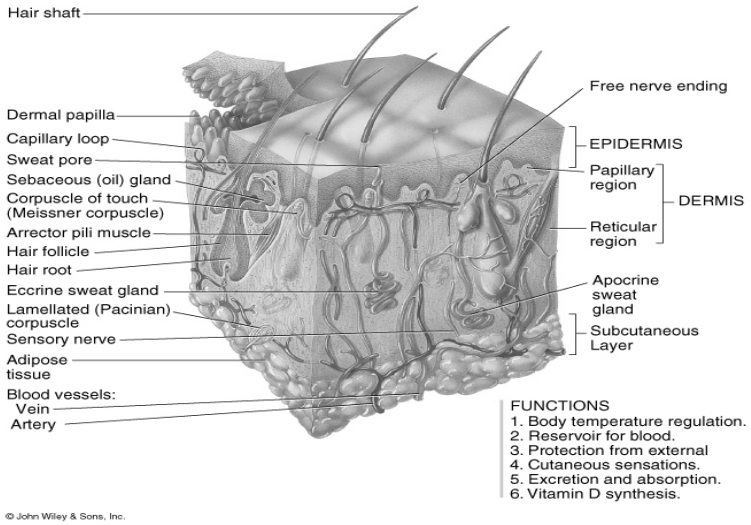
FUNCTIONS OF SKIN

- ***blood reservoir***
  - extensive network of blood vessels
- ***protection*** - physical, chemical and biological barriers
  - tight cell junctions prevent bacterial invasion
  - lipids released retard evaporation
  - pigment protects somewhat against UV light
  - Langerhans cells alert immune system
- ***cutaneous sensations***
  - touch, pressure, vibration, tickle, heat, cold, and pain arise in the skin

FUNCTIONS OF SKIN

- ***Synthesis of Vitamin D***
  - activation of a precursor molecule in the skin by UV light
  - enzymes in the liver and kidneys modify the activated molecule to produce calcitriol, the most active form of vitamin D.
  - necessary vitamin for absorption of calcium from food in the gastrointestinal tract
- ***excretion***
  - 400 mL of water/day, small amounts salt, CO_2, ammonia and urea

Introduction to the Integumentary System



Integumentary System

Cutaneous membrane

- Protects tissues from physical trauma, biological pathogens, and chemical trauma
- Provides sensations

Accessory Structures

- Provides sensations
- Produces secretions
- Protects epidermal surfaces

Cutaneous Membrane

Epidermis:

- Controls skin permeability
- Prevents entry of biological pathogens
- Synthesizes vitamin D

Dermis:

- Nourishes and supports epidermis
- Restricts spread of pathogens
- Stores lipids
- Attaches skin to underlying tissue
- Sensory receptors provide sensations
- Blood vessels assist in thermoregulation

Accessory Structures

Hair Follicles:

- Produce hair that protects underlying skin
- Provide sensations

Nails:

- Protect and support the tips of fingers and toes

Exocrine Glands:

- Assist in thermoregulation
- Excrete wastes
- Lubricate epidermis and hair
- Produce pheromones for chemical communication

Specific Layer of the Skin

Epidermis:

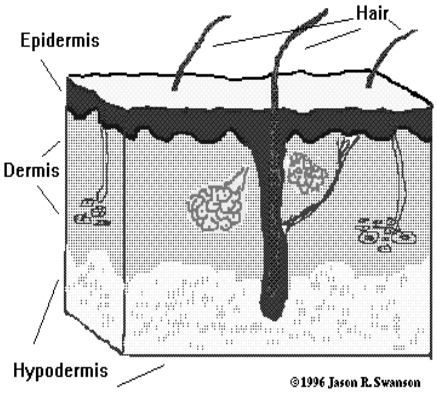
- Composed of keratinized stratified squamous epithelium

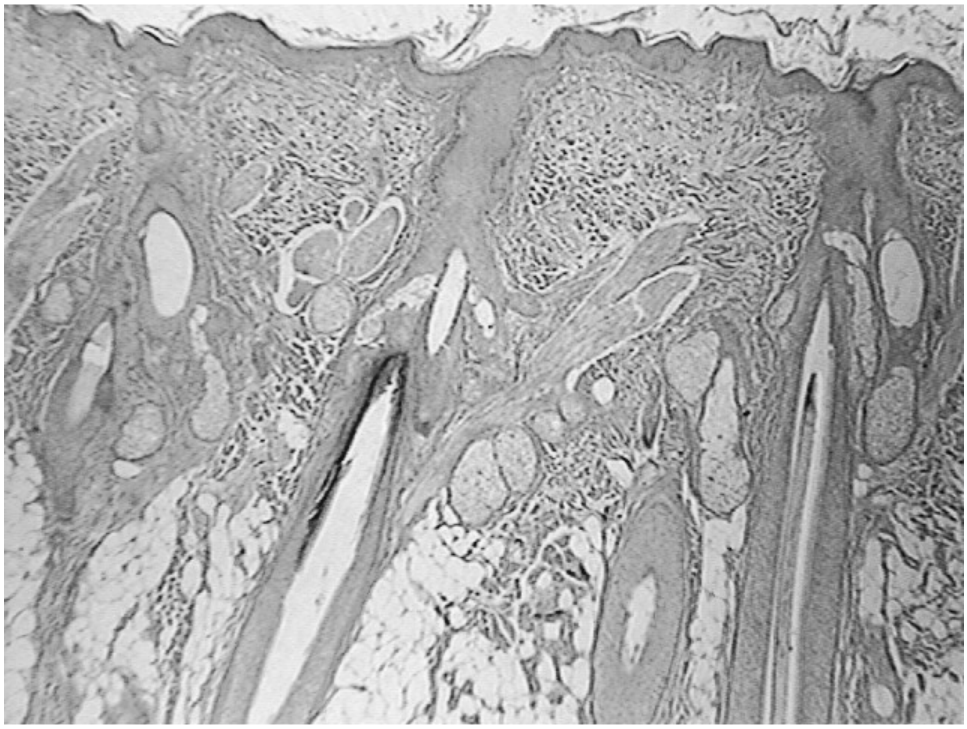
Dermis:

- Papillary region composed of areolar tissue
- Reticular region composed of dense irregular connective tissue

Hypodermis:

- Composed of areolar tissue with abundant adipocytes





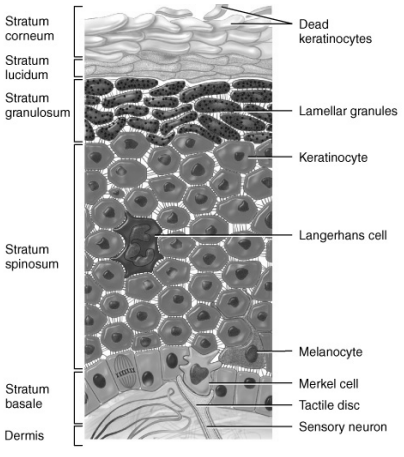
Specific Layers of the Epidermis

Stratum Basale:

- Mitotic layer, continuously replaces epidermal cells, turnover rate between 25 to 50 days

Stratum Spinosum:

- Cells are pushed upward and flatten out
- Stratum Granulosum: Cells contain granules of Keratin



(a) Four principal cell types in epidermis

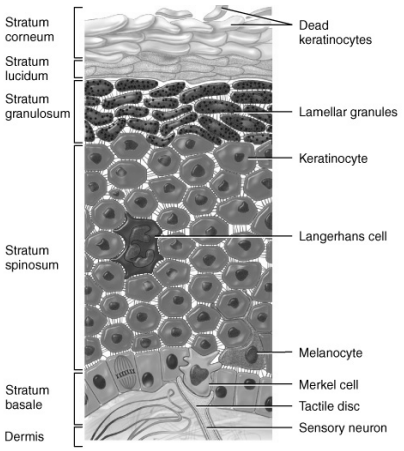
Specific Layer of the Epidermis

Stratum Lucidum:

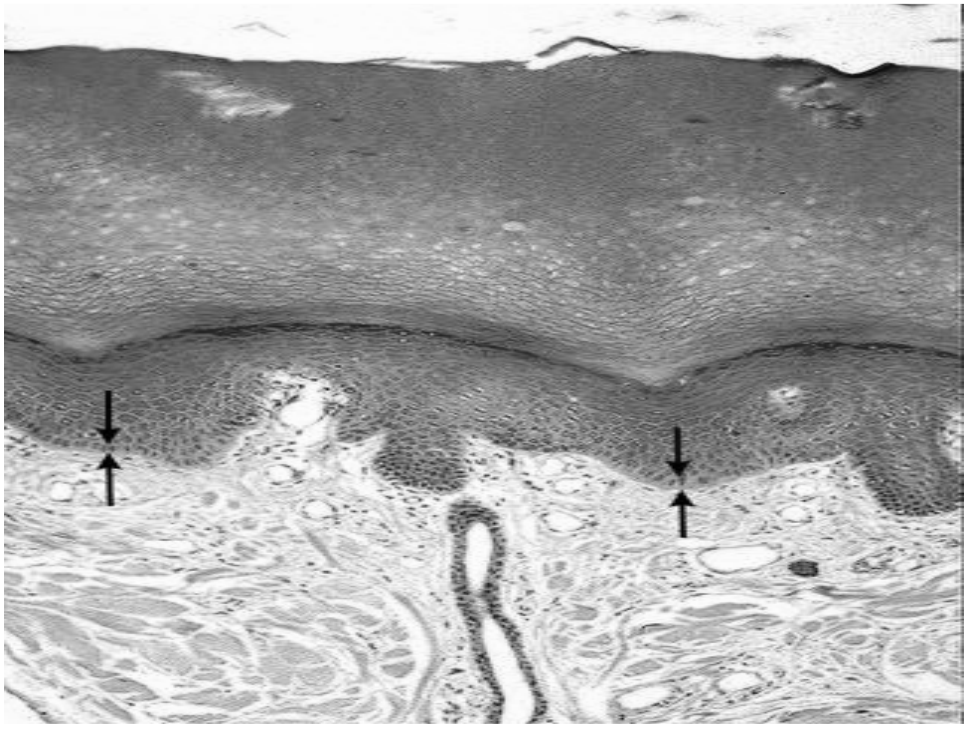
- Observed only in non-hairy or thick skin. Several layers of dead cells with indistinct boundaries

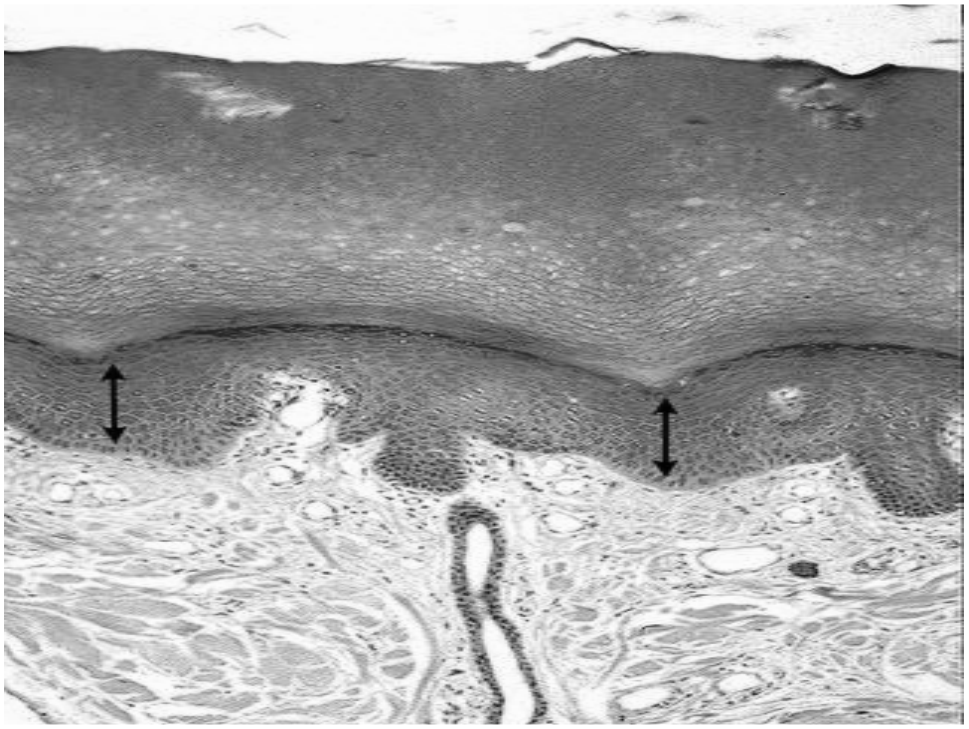
Stratum Corneum:

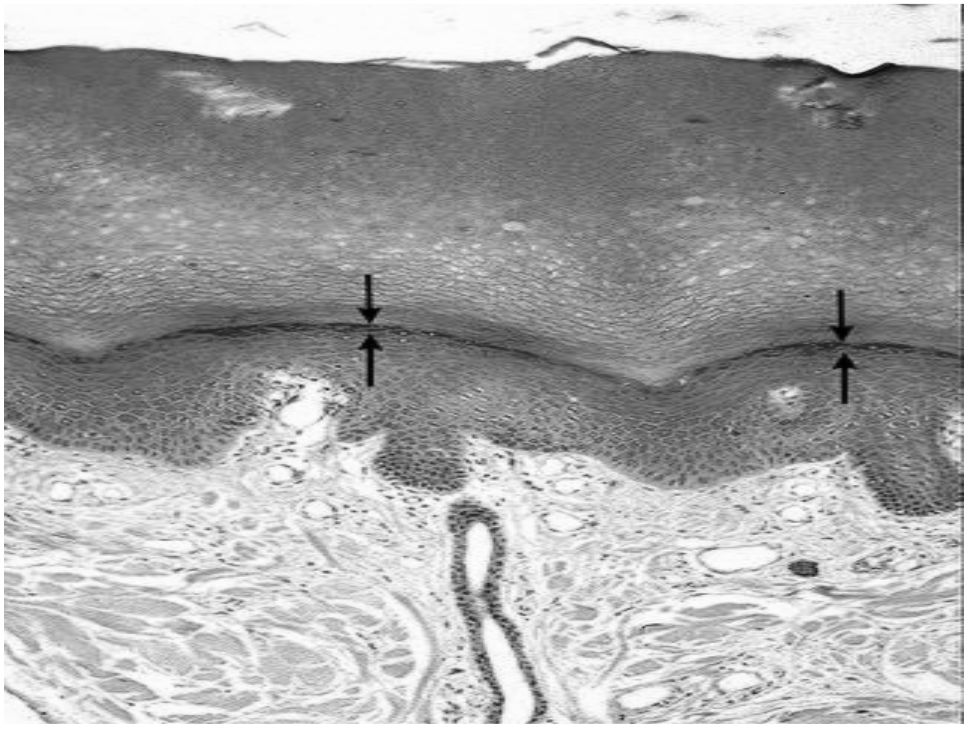
- Composed of 25 or more layers of dead squamous cells still joined by desmosomes. Eventually desmosomes break and cells flake off in a process called desquamation

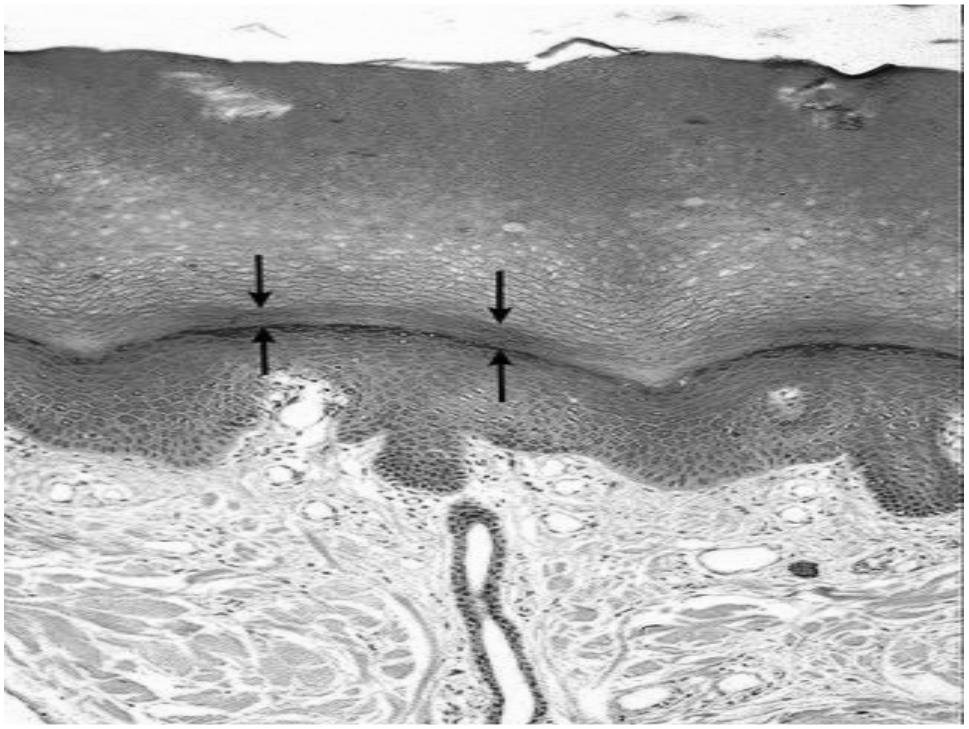


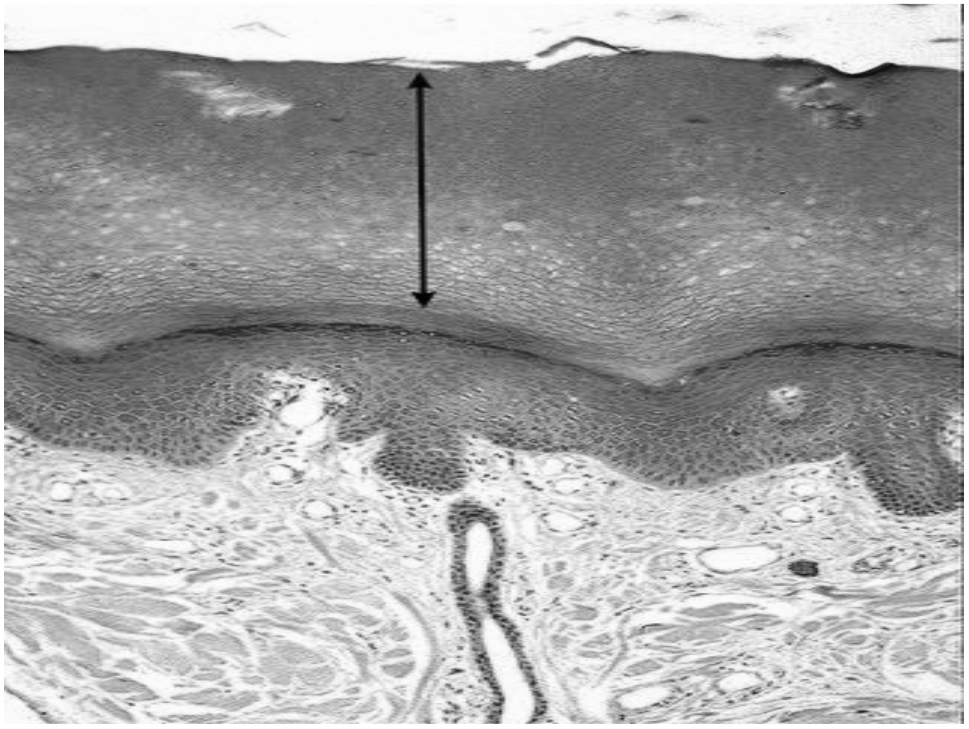
(a) Four principal cell types in epidermis

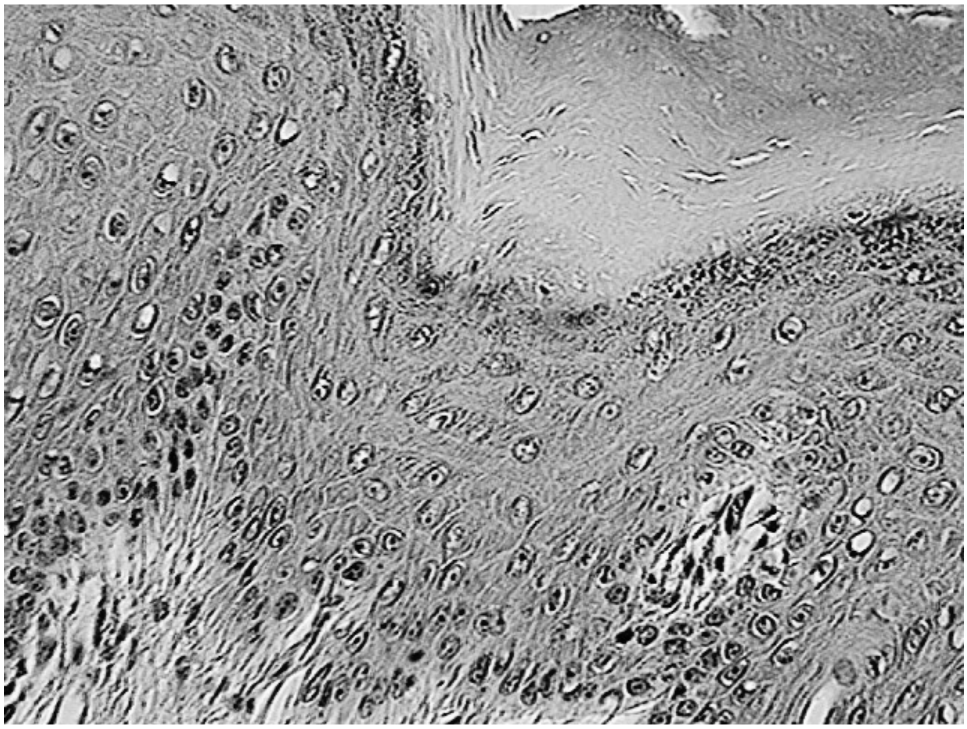


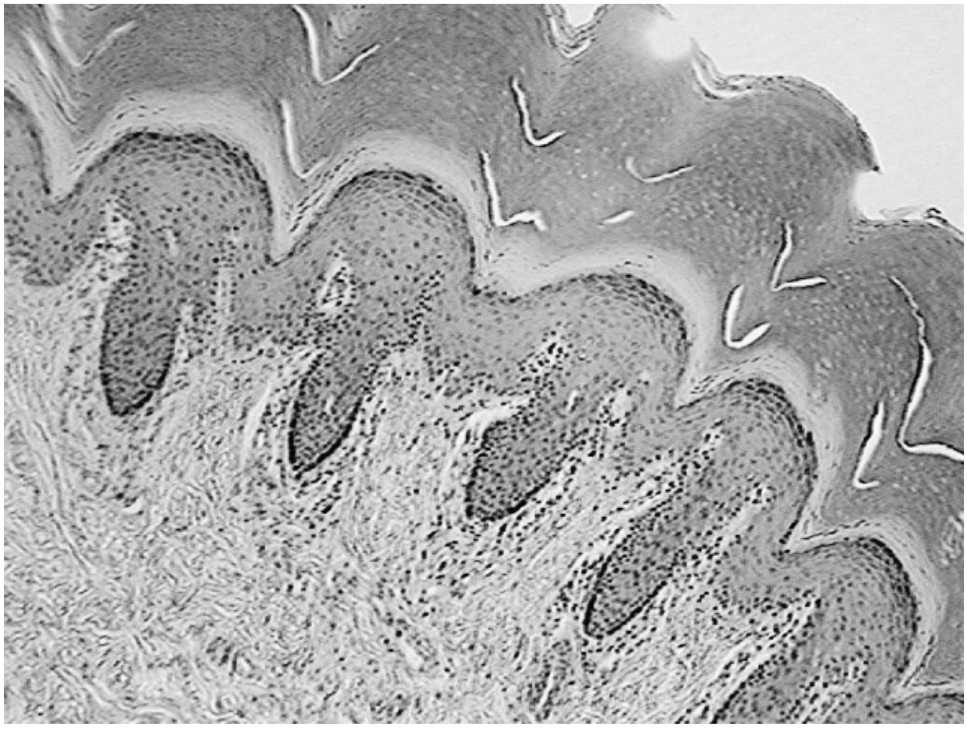












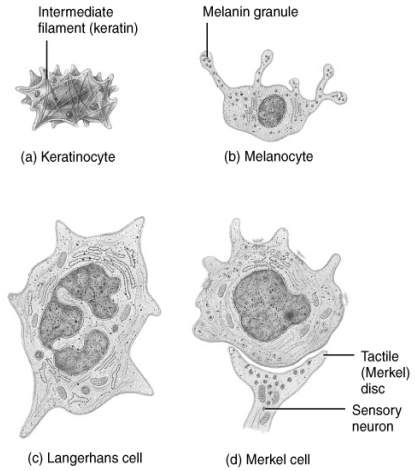
Specialized Cells of the Epidermis

Keratinocytes:

Most common cells of the epidermis. Provides protection and waterproofing sealant

Melanocytes:

Produces and transfer the protein melanin to Keratinocytes. Melanin is a brown/black pigment that absorbs UV-light.



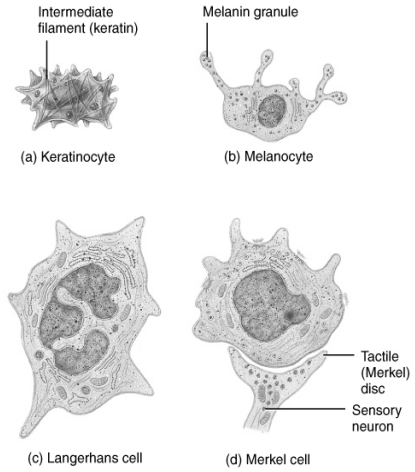
Specialized Cells of the Epidermis

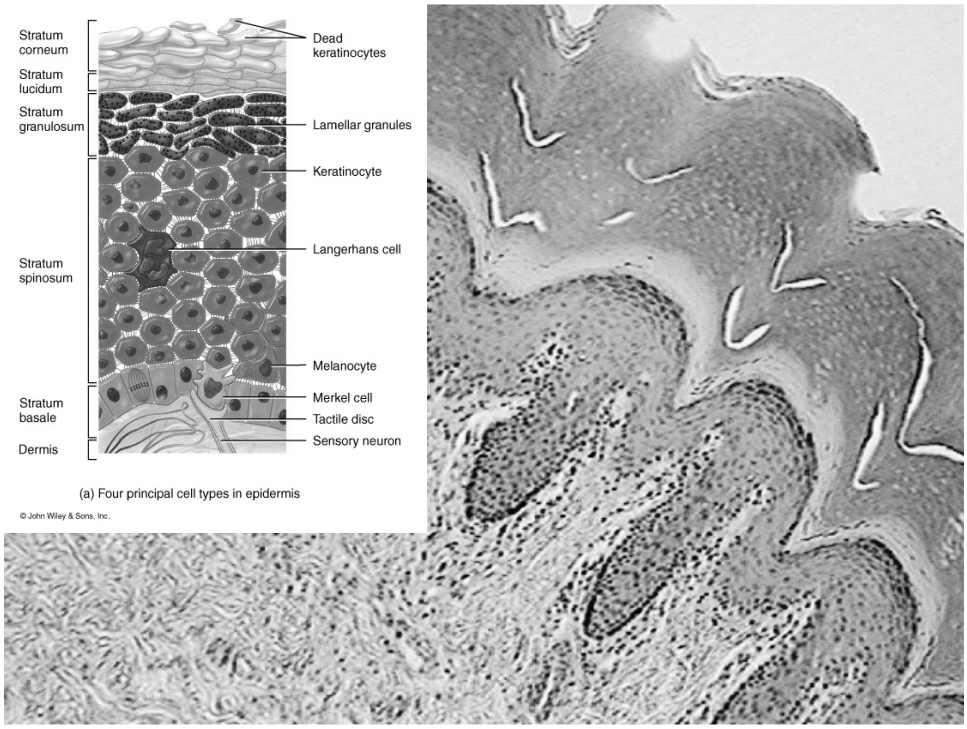
Langerhans cells:

Arise from red bone marrow and migrate to the epidermis. They participate in immune responses against bacteria and viruses. Easily damaged by UV

Merkel Cells:

Found in the Stratum Basale, they contact the flattened process of sensory neuron. They respond to touch sensations





Skin Color Pigments

- ***Melanin*** produced in epidermis by melanocytes
  - melanocytes convert tyrosine to melanin
    - UV in sunlight increases melanin production
  - same number of melanocytes in everyone, but differing amounts of pigment produced
  - results vary from yellow to tan to black color
- Clinical observations
  - freckles or liver spots = melanocytes in a patch
  - albinism = inherited lack of tyrosinase; no pigment
  - vitiligo = autoimmune loss of melanocytes in areas of the skin produces white patches
- The wide variety of colors in skin is due to three pigments - melanin, carotene, and hemoglobin (in blood in capillaries) - in the dermis.

Skin Color Pigments

Carotene in dermis:
yellow-orange pigment (precursor of vitamin A)
found in stratum corneum & dermis

Hemoglobin in dermis:
red, oxygen-carrying pigment in blood cells
if other pigments are not present, epidermis is translucent so pinkness will be evident

Skin Cancer

- Induced by UV rays of the sun
  - basal cell carcinoma (least dangerous)
    - arises from stratum basale and invades dermis
  - squamous cell carcinoma
    - arises from keratinocytes in stratum spinosum
    - metastasis to the lymph nodes can be lethal
  - malignant melanoma (most deadly)
    - arises from melanocytes of a preexisting mole
    - ABCD--asymmetry, border irregular, color mixed and diameter over 6 mm
    - Result of oncogene BRAF in men

Abmornal Skin Color

- Cyanosis = blueness from deficiency of oxygen in the circulating blood (cold weather)
- Erythema = redness due to dilated cutaneous vessels (anger, sunburn, embarrassment)
- Jaundice = yellowing of skin and sclera due to excess of bilirubin in blood (liver disease)
- Bronzing = golden-brown color of Addison disease (deficiency of glucocorticoid hormone)
- Pallor = pale color from lack of blood flow
- Albinism = a genetic lack of melanin
- Hematoma = a bruise (visible clotted blood)

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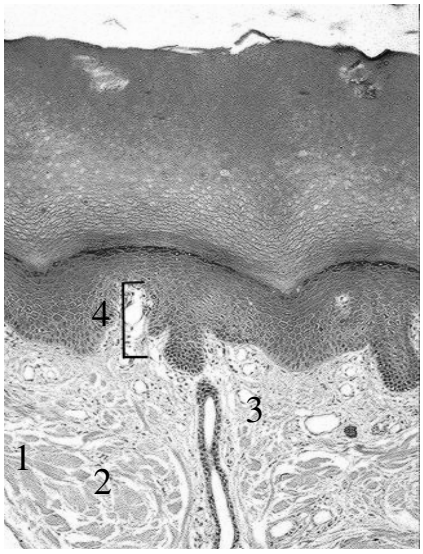
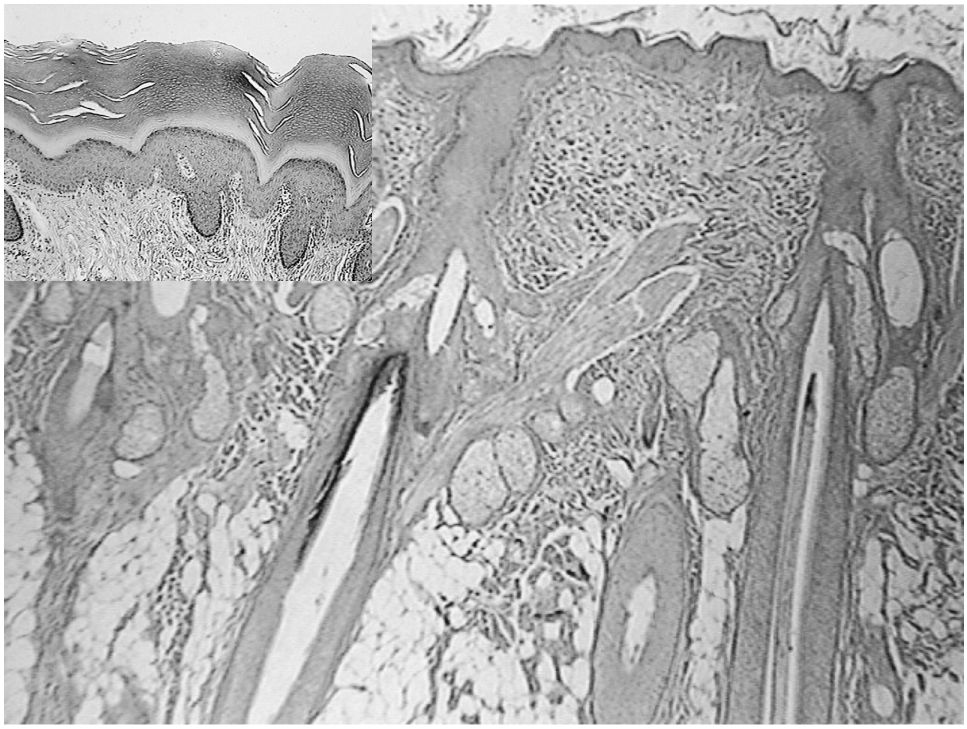
Layers of the Dermis

Dermis

- ***Reticular region:***
  consists of dense irregular CT
  Contain most of the accessory Structures
3. ***Papillary Region:***
   Consist of areolar Tissue
4. ***Dermal Papilla:***
   Fingerlike projections that greatly increase surface area





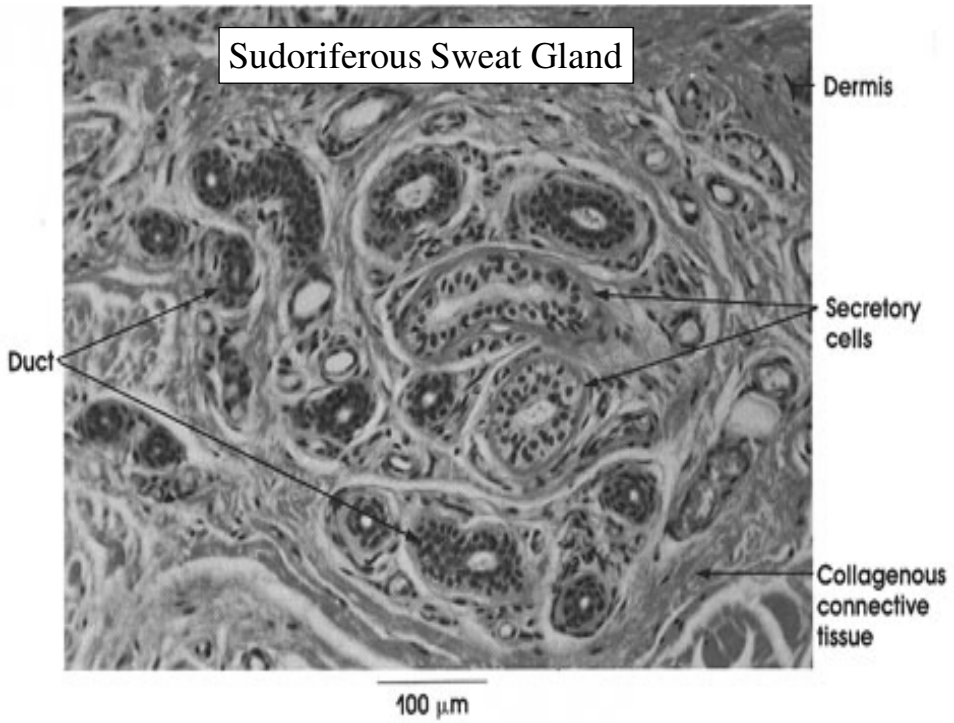
Accessory Structures of the Dermis

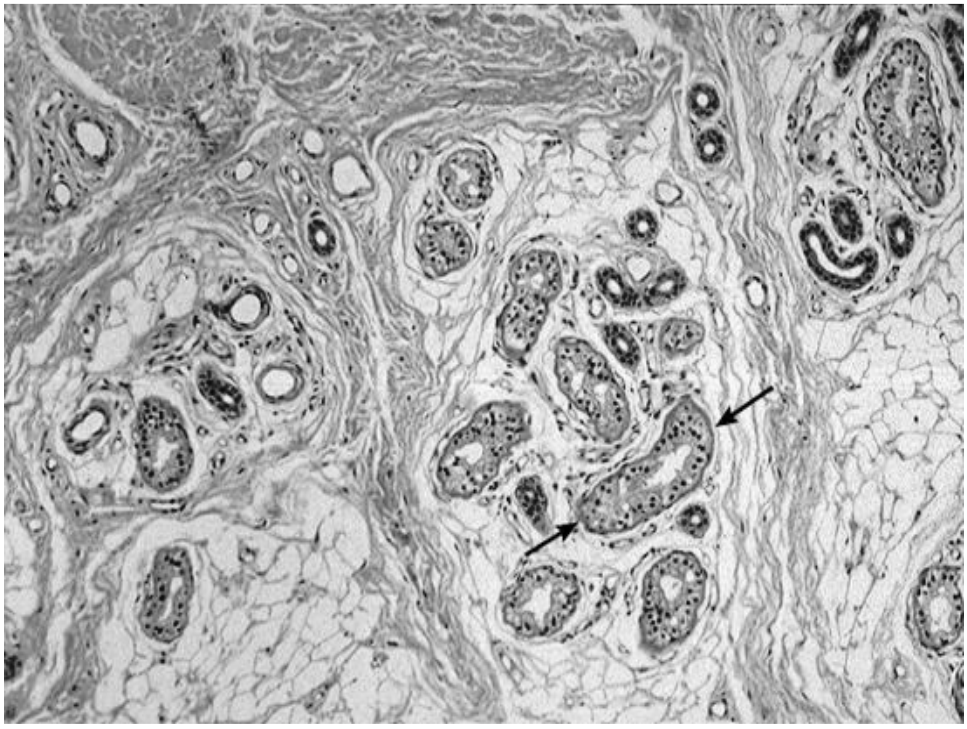
Apocrine sweat glands:

- Found in the Axillae, nipples, labia, and glans penis.
- Begin to function at puberty and are affected by hormones
- Produce odorous thick secretion
- Possible pheromone function

Sudoriferous (eccrine) Sweat Gland:

- Widespread (3,000/sq. in.)
- Produce thin watery secretion
- Controlled by nervous system
- Thermoregulation
- Excretion of urea
- Antibacterial action

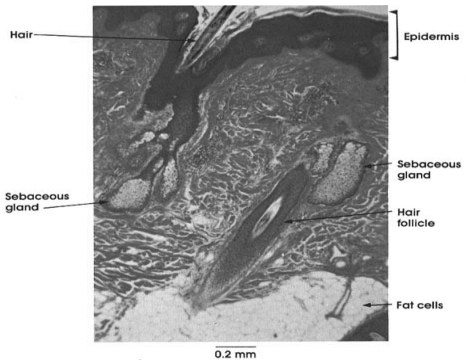

Sudoriferous Sweat Gland
Dermis
Secretory cells
Duct
Collagenous connective tissue
100 μm

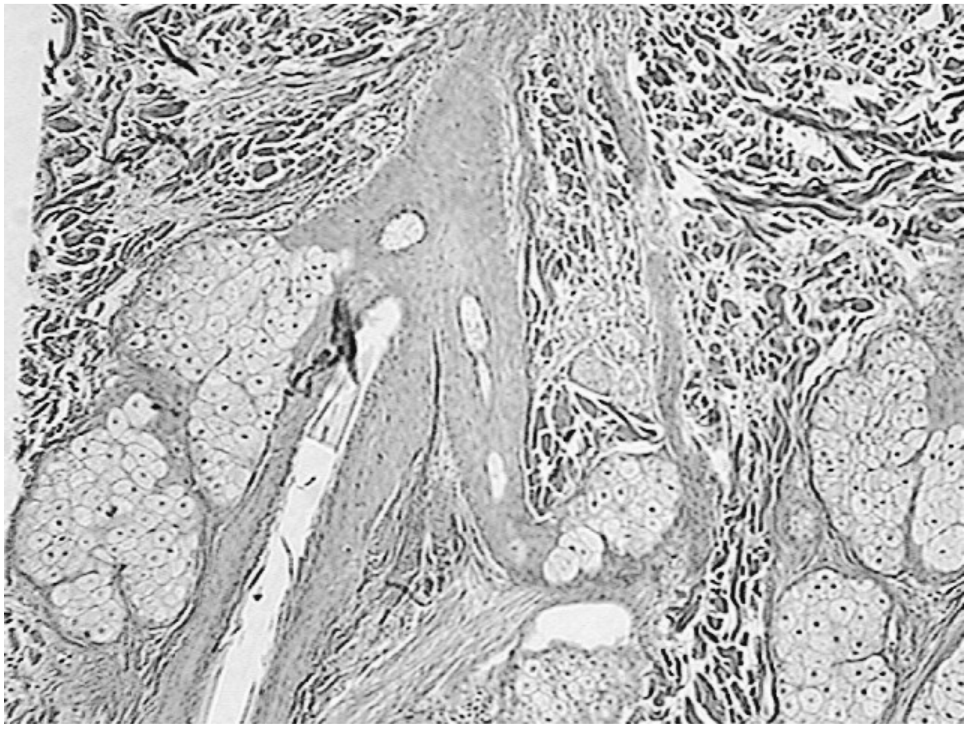


Accessory Structures of the Dermis

Sebaceous "Oil" gland:

- Secrete sebum
- Coats hair shaft and lubricates the epidermis
- Secreted to hair follicles
- Not association with hair on the labia, glans penis, and lips
- Activity controlled by sex-hormones
- Modified in external ear canal to produce cerumen or ear wax (ceruminous glands)

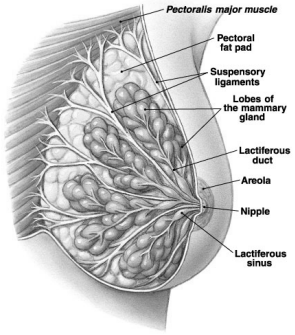




Accessory Structures of the Dermis

Mammary Glands:

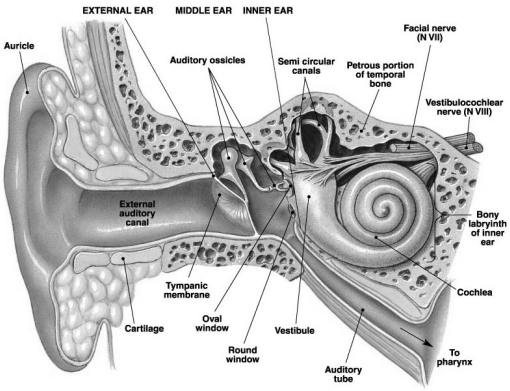
- Anatomically related to apocrine sweat glands
- Development controls by sex hormones and pituitary hormones
- Produce milk



Accessory Structures of the Dermis

Ceruminous Glands:

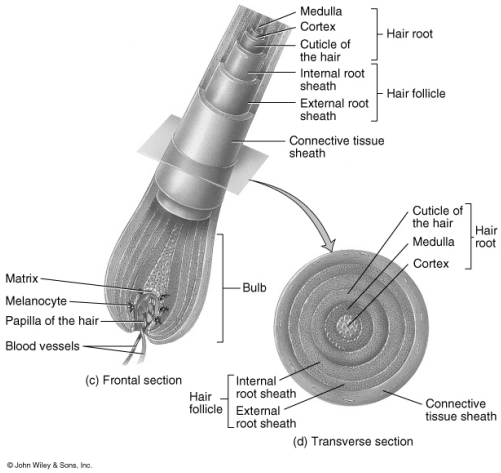
- Modified sweat glands found in the external auditory canal
- Produce cerumen or ear wax
- Helps trap foreign particles from reaching the eardrum



Accessory Structures of the Dermis

Hair:

- Present on most skin except palmer surface, and plantar surface
- Growth controlled by genetics and sex hormones
- Provides protection and sensory input
- Each hair has an arrector pili muscle



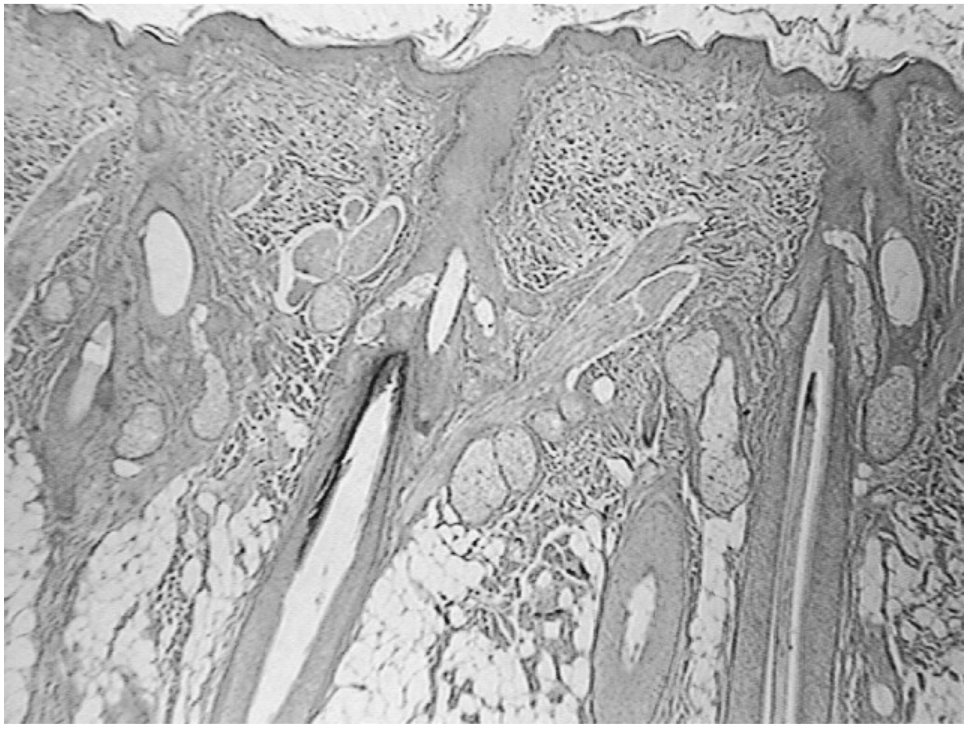
Hair Growth

- The hair growth cycle consists of a growing stage and a resting stage.
  - Growth cycle = growth stage & resting stage
    - Growth stage
      - lasts for 2 to 6 years
      - matrix cells at base of hair root producing length
    - Resting stage
      - lasts for 3 months
      - matrix cells inactive & follicle atrophies
  - Old hair falls out as growth stage begins again
    - normal hair loss is 70 to 100 hairs per day

- Both rate of growth and the replacement cycle can be altered by illness, diet, high fever, surgery, blood loss, severe emotional stress, and gender.
- Chemotherapeutic agents affect the rapidly dividing matrix hair cells resulting in hair loss.

Hair Color

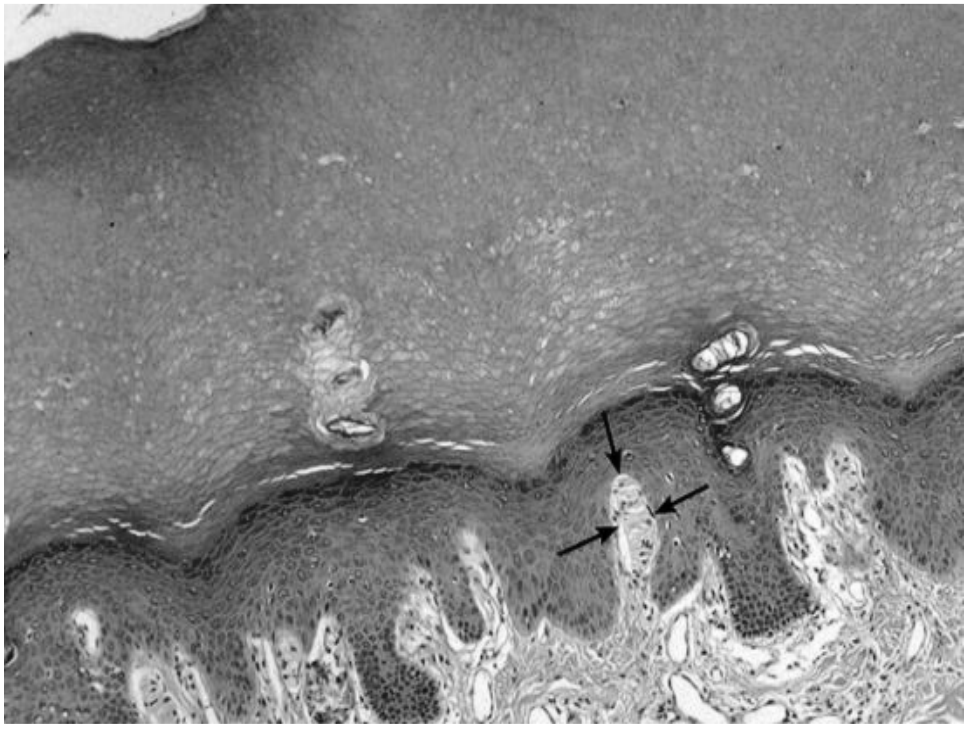
- ***Hair color*** is due primarily to the amount and type of melanin.
- Graying of hair occurs because of a progressive decline in tyrosinase.
  - Dark hair contains true melanin
  - Blond and red hair contain melanin with iron and sulfur added
  - Graying hair is result of decline in melanin production
  - White hair has air bubbles in the medullary shaft
- Hormones influence the growth and loss of hair (Clinical applications).

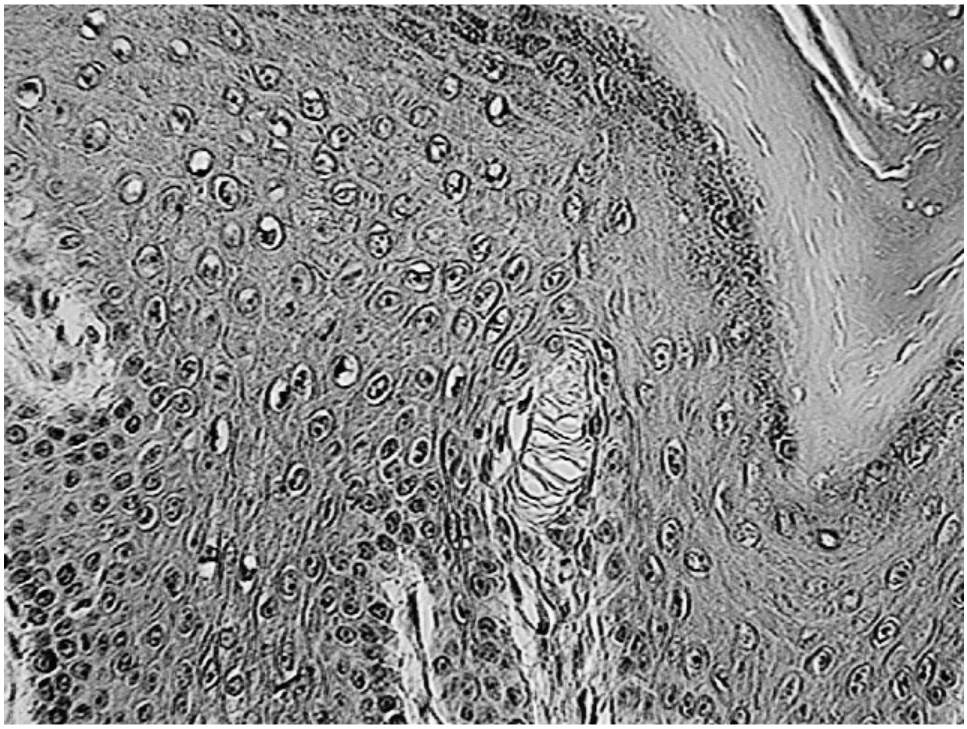


Special Sensory apparatus of the dermis

Meissner's Corpuscles:

- Present in dermal papilla
- Specialized sensory neuron nerve endings
- Respond to touch
- Most numerous in thick or non-hairy skin of the palmar and plantar surfaces

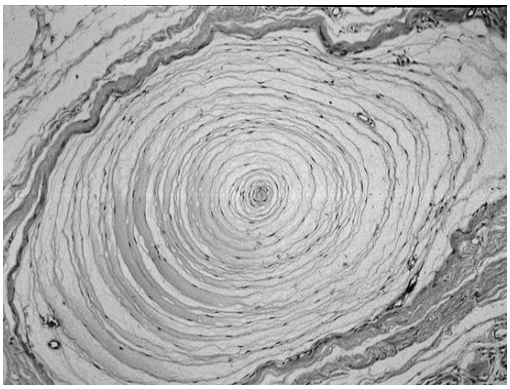


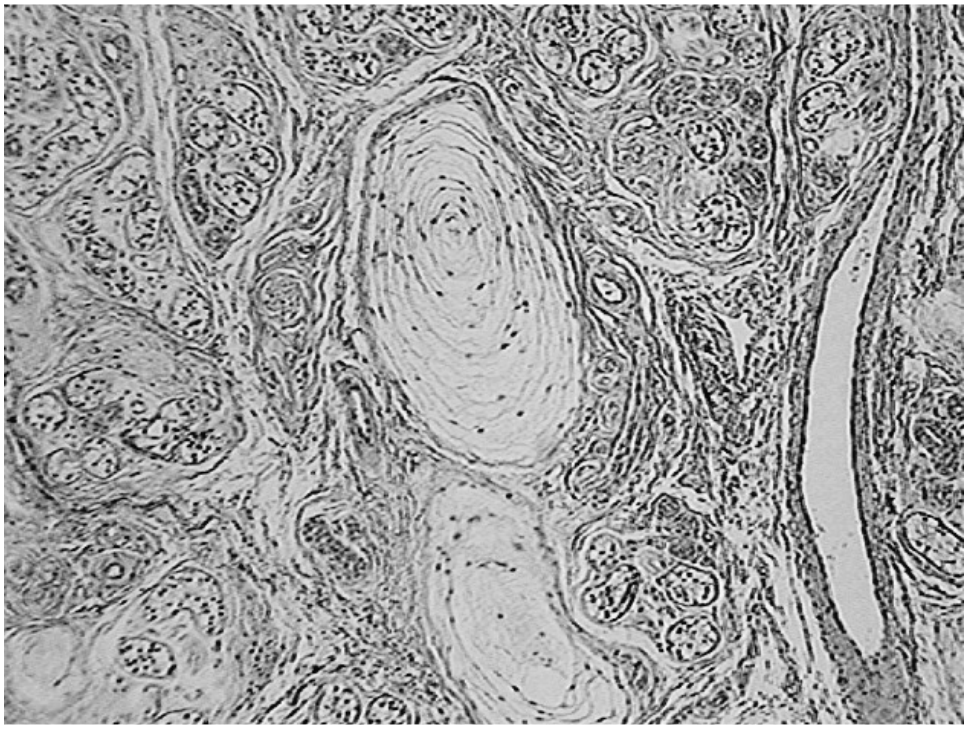


Special Sensory Apparatus of the Dermis

Pacinian Corpuscle:

- Encapsulated sensory nerve ending
- Located at the hypodermis/dermis junction
- Respond to pressure





Deep Wound Healing

- When an injury extends to tissues deep to the epidermis, the repair process is more complex than epidermal healing, and scar formation results.
- Healing occurs in 4 phases
  - ***inflammatory phase*** has clot unite wound edges and WBCs arrive from dilated and more permeable blood vessels
  - ***migratory phase*** begins the regrowth of epithelial cells and the formation of scar tissue by the fibroblasts
  - ***proliferative phase*** is a completion of tissue formation
  - ***maturation phase*** sees the scab fall off
- Scar formation
  - hypertrophic scar remains within the boundaries of the original wound
  - keloid scar extends into previously normal tissue
    - collagen fibers are very dense and fewer blood vessels are present so the tissue is lighter in color

Four Phases of Deep Wound Healing

1. ***Inflammatory stage:***
   a. Blood clot forms
   b. Inflammation is the result of vasodilation which helps deliver WBC's to help eliminate microbes

Four Phases of Deep Wound Healing

2. ***Migratory Phase:***
   a. Clot becomes a scab
   b. Epithelial cells migrate beneath scab to repair epithelium
   c. Fibroblast migrate into the area to repair connective tissue
   d. New tissue is called granulation tissue

Four Phases of Deep Wound Healing

3. Proliferative phase:

a. Extensive growth of epithelial cells

b. Deposition of collagen fibers by fibroblasts

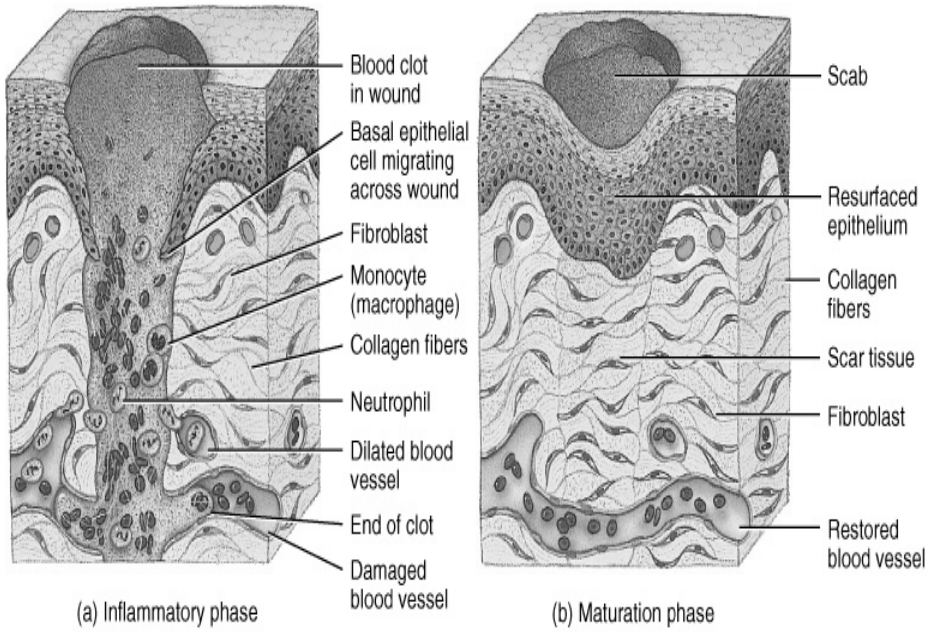
c. Continued growth of vascular network

4. Maturation phase:

a. Scab sloughs off

b. Collagen fibers become more organized

c. Fibroblasts decrease in number



Age Related Structural Changes

- Collagen fibers decrease in number & stiffen
- Elastic fibers become less elastic
- Fibroblasts decrease in number
- decrease in number of melanocytes (gray hair, blotching)
- decrease in Langerhans cells (decreased immune responsiveness)
- reduced number and less-efficient phagocytes

Burns

- Hot water, sunlight, radiation, electric shock or acids and bases
- Death from fluid loss and infection
- Degrees of burns
  - 1st-degree = only the epidermis (red, painful and edema)
  - 2nd-degree = epidermis and part of dermis (blistered)
    - epidermis regenerates from hair follicles and sweat glands
  - 3rd-degree = epidermis, dermis and more is destroyed
    - often requires grafts or fibrosis and disfigurement may occur
- Treatment – IV nutrition and fluid replacement, debridement and infection control

Skin Grafts and Artificial Skin

- Third-degree burns require skin grafts
- Graft options
  - autograft -- tissue from patient
  - isograft -- tissue from identical twin
  - cultured keratinocyte patches
- Temporary grafts (immune system)
  - homograft (allograft) -- from unrelated person
  - heterograft (xenograft) -- from another species
  - amnion from afterbirth
  - artificial skin from silicone and collagen