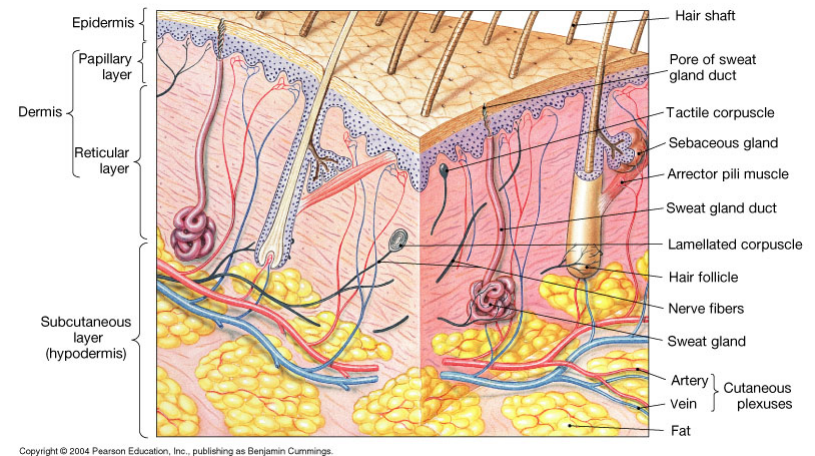


BI204 CHAP 5

Integumentary System

Integumentary System

- 1st major component – cutaneous membrane – 2 parts – epidermis (epithelium) and dermis (underlying CT)
- 2nd major component – accessory structures – hair, nails, multicellular exocrine glands
- 3rd component – subcutaneous layer or hypodermis or superficial fascia

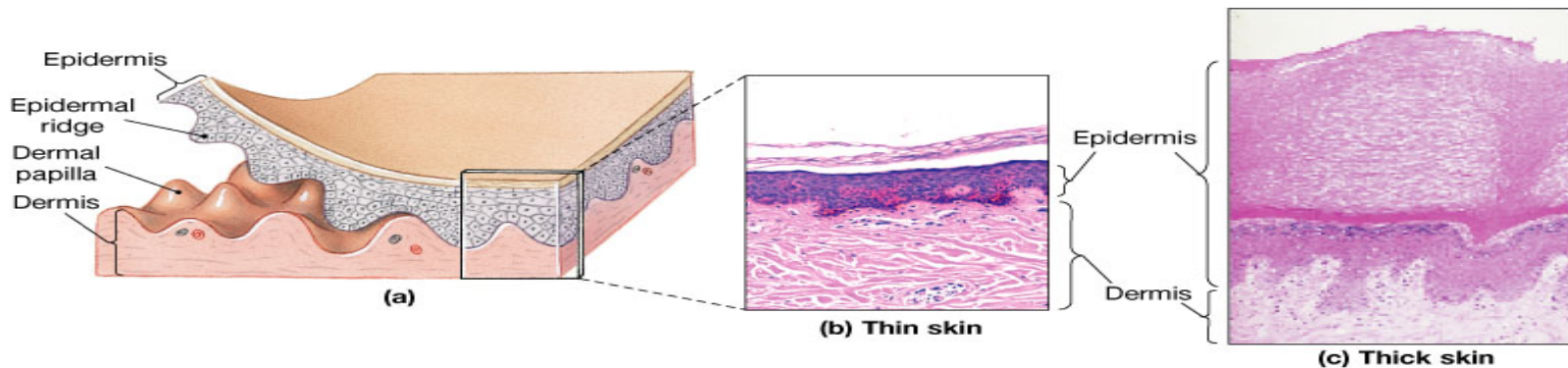


Integumentary System - Functions

- Protection of underlying tissues
- Excretion of salts, water & organic wastes by glands
- Maintenance of normal body temp through insulation or evaporative cooling
- Synthesis of the steroid vitamin D which is converted to hormone calcitriol – important to normal calcium metabolism
- Storage of nutrients – lipids stored in adipocytes
- Detection of touch, pressure, pain, temperature stimuli

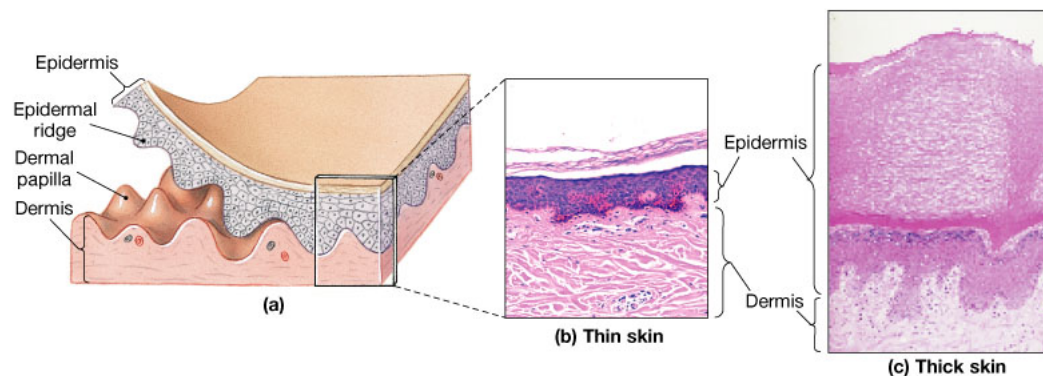
Epidermis

- Stratified squamous epithelium giving mechanical protection & keeps bacteria out
- Epidermis is avascular so most active cells close to basal lamina & cells far away are dead
- Keratinocytes are most abundant epithelial cells & form several layers



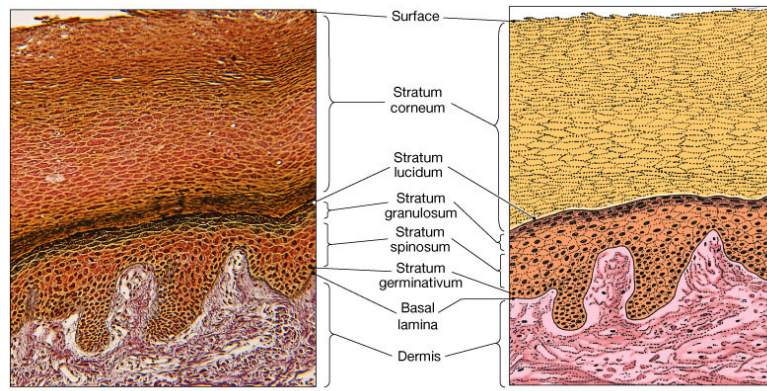
Epidermis cont.

- Layers come in 2 types – thick skin on palms & soles of feet – 5 layers and thin skin with 4 layers on rest of body
- Thick and thin skin refer to epidermis only not to dermis



Epidermis – Layers & Cell Types

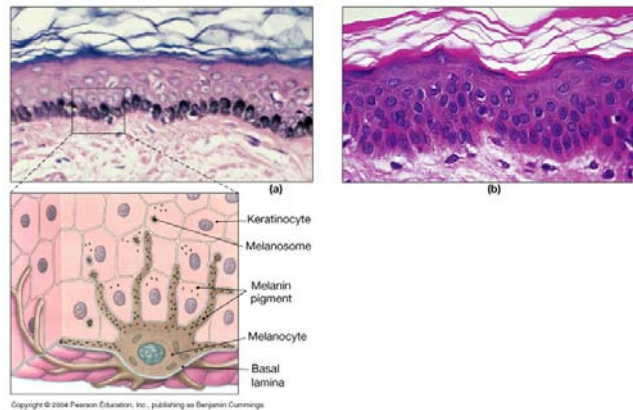
- Stratum (layer) basale or germinativum, stratum spinosum, stratum granulosum, stratum lucidum, stratum corneum
- Stratum basale is innermost & cells attached to basal lamina by hemidesmosomes
- Large basal cells prominent in this layer & replace lost cells by cell division



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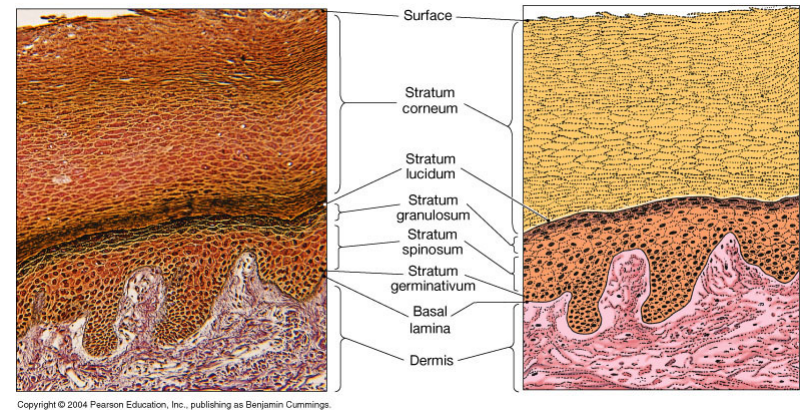
Epidermis – Layers & Cell Types cont.

- Skin without hair has cells in S. basale called Merkel cells which are sensitive to touch
- Brown tones in skin result from pigment cells called melanocytes which sit in S. basale & send processes to more superficial layers



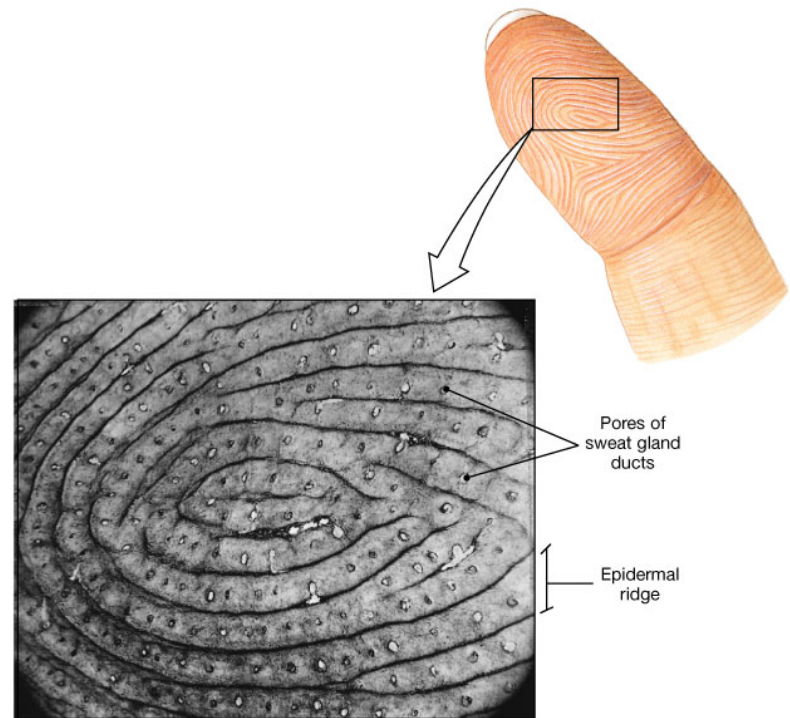
Epidermis – Layers & Cell Types cont.

- S basale has epidermal ridges extending into dermis and dermal papillae extending between epidermal ridges which increase surface area so increase attachment of epidermis to dermis



Epidermis – Layers & Cell Types cont.

- Contours of skin surface follow ridges which on palms & soles increase friction to enhance grip
- Ridge shapes genetically determined – called fingerprints - & used for identification

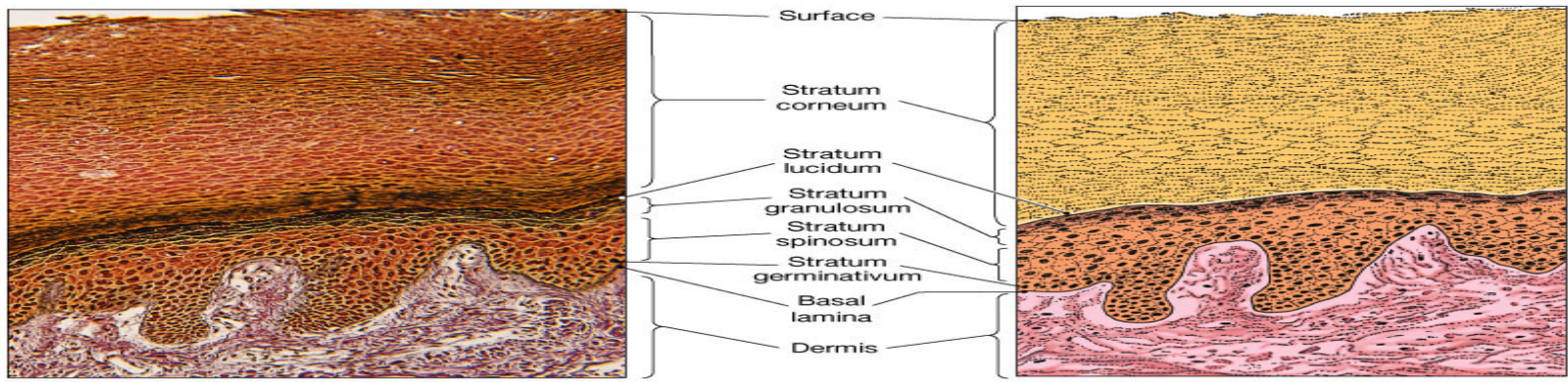


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Epidermis – layers & Cell Types

cont.

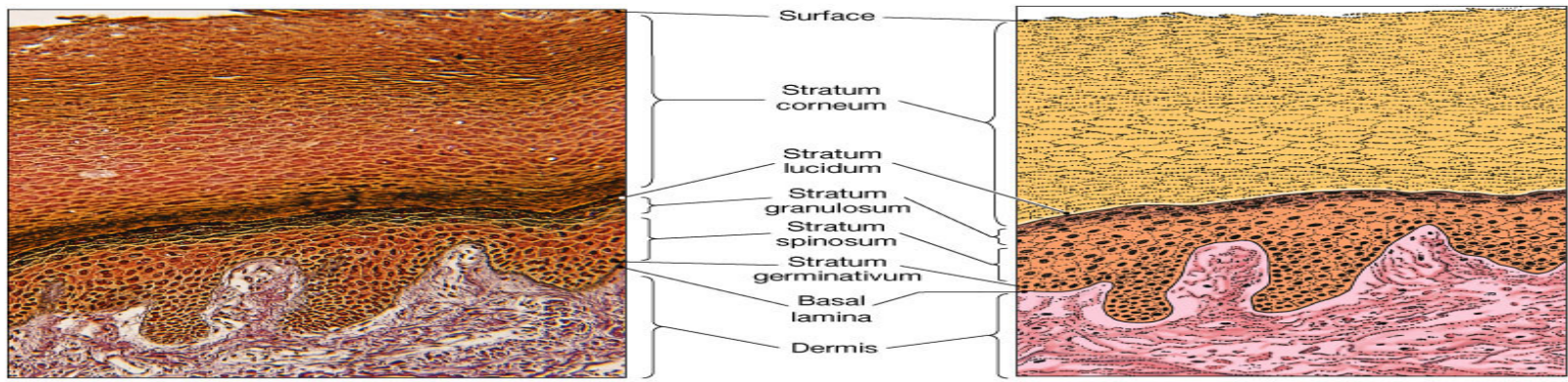
- Stratum spinosum – 8-10 layers of keratinocytes joined by desmosomes
- Layer contains Langerhans cells – macrophage type cells functioning in immune responses against bacteria or superficial skin cancers



Epidermis – Layers & Cell Types

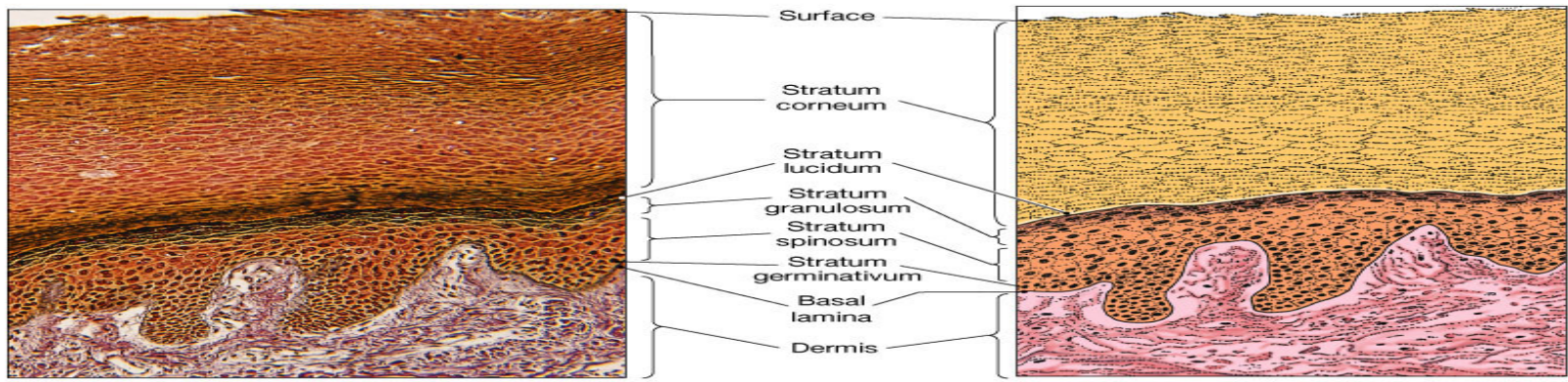
cont.

- Stratum granulosum – 3-5 layers of nondividing keratinocytes which make large amounts of the proteins keratin & keratohyalin
- Cells grow thin & flat & keratohyalin granules in cytoplasm promote cell dehydration & membranes are less permeable so cells die



Epidermis – Layers & Cell Types cont.

- Stratum lucidum – in thick skin only this layer is glassy or clear & cells are flattened, densely packed & filled with keratin

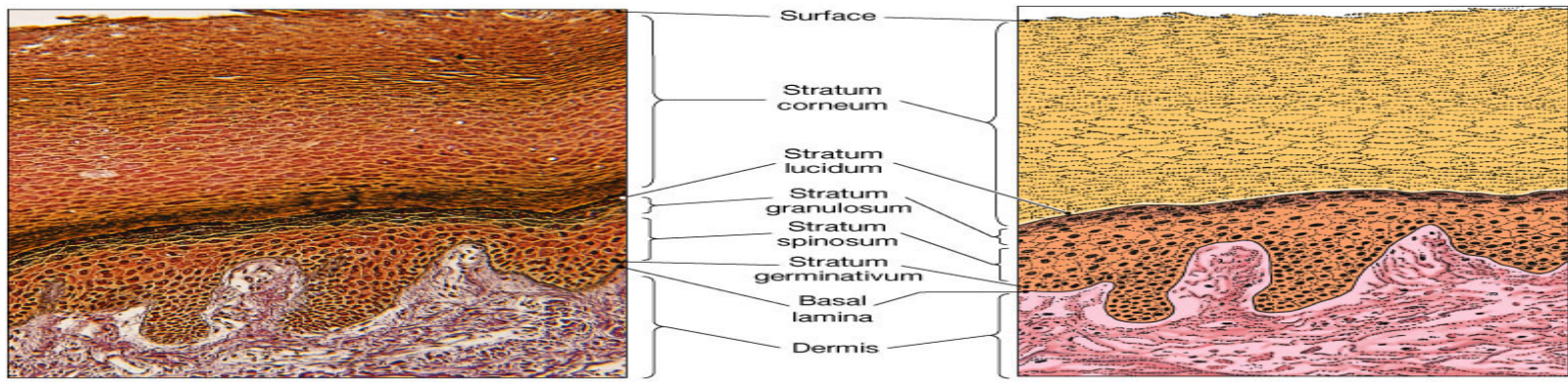


Epidermis – Layers & Cell Types cont.

- Stratum corneum – 15-30 layers of keratinized cells – cells filled with keratin
- Dead cells still joined by desmosomes so dead cells shed in sheets
- 15-30 days for cells to travel to surface where cells stay for 2 more weeks – dead cell layers act as barrier & protective coat
- Surface maintained by lipid secretions of sebaceous glands
- S. corneum is water resistant not waterproof since water evaporates from surface – called insensible perspiration

Epidermis – Layers & Cell Types cont.

- Stratum corneum cont. – sensible perspiration due to active sweat glands
- Blisters are accumulations of water between superficial & deep layers of epidermis or between epidermis & dermis

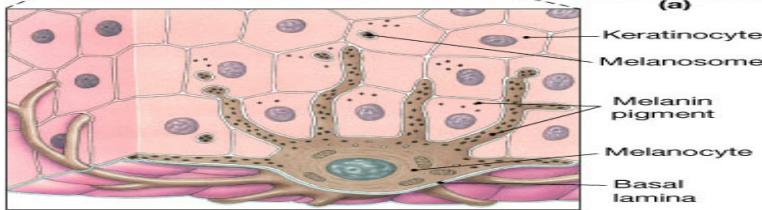
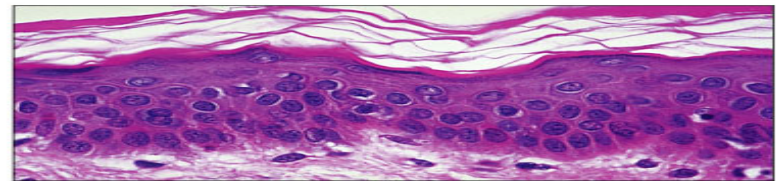
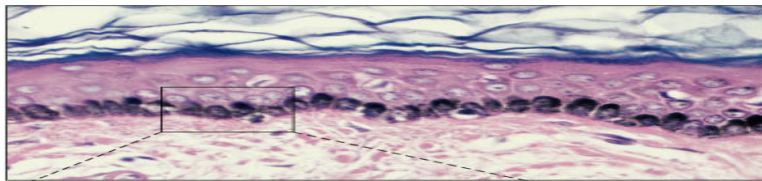


Skin Color

- Skin color is result of interaction between epidermal pigmentation & dermal circulation
- Epidermis has 2 pigments – carotene & melanin
- Carotene is orange – yellow pigment which accumulates in epidermal cells & fat tissues of dermis & is converted to vitamin A
- Vitamin A required for maintenance of epithelia & for synthesis of pigments in eye
- Melanin is brown, yellow-brown, or black pigment produced by melanocytes

Skin Color cont.

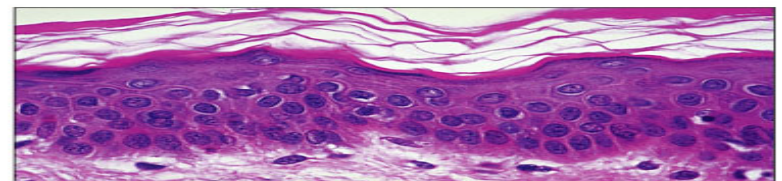
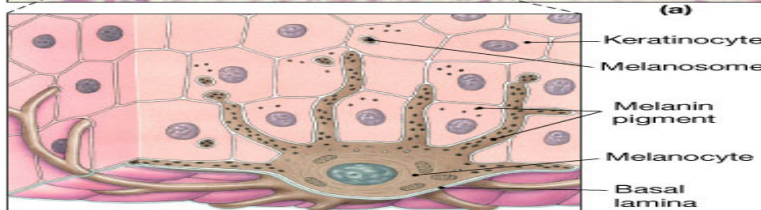
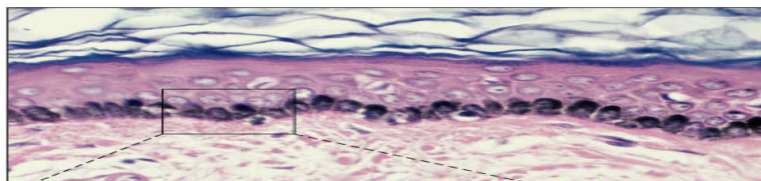
- Melanocytes – in S. basale where make melanin from tyrosine, pack it in granules called melanosomes
- Granules are secreted outside the melanocytes & accumulate in keratinocytes near the nucleus protecting DNA from damage caused by UV radiation



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Skin Color cont.

- Melanosomes destroyed by fusion with lysosomes & in individuals with pale or dark skin this process occurs in deeper or more superficial layers
- Ratio of melanocytes to basal cells varies between body regions but is same for different ethnic groups
- Only difference between groups is difference in synthetic rate of melanin



Dermal Circulation

- Blood has red blood cells filled with pigment hemoglobin which is bright red when oxygen is bound
- When oxygen is not bound hemoglobin is darker & skin surface looks bluish or cyanotic as seen in lips
- Freckles – small areas of pigment accumulation due to more active melanocytes
- Diseases – jaundice, Addison's disease, vitiligo, all have effects on melanocytes

Epidermis, Vitamin D₃, Epidermal Growth Factor

- Limited exposure to sunlight beneficial as cells in S. basale & S. spinosum convert cholesterol related steroid to vitamin D₃ or cholecalciferol which is converted in liver to intermediary which is converted to calcitriol in kidney calcitriol needed for calcium absorption & phosphorus – vitamin D milk
- Epidermal growth factor – peptide growth factor produced by salivary glands and duodenal glands with effects on epithelia esp. epidermis - like promotion of cell division, increase in production of keratin, stimulation of repair & of synthetic activity & secretion of glands

Dermis

- Dermis has superficial papillary layer & deeper reticular layer
- Papillary layer consists of areolar CT & has capillaries & sensory neurons & dermal papillae which project between epidermal ridges
- Reticular layer consists of dense irregular CT with lots of collagen bundles & all the cell types of CT proper
- Accessory structures such as hair follicles & sweat glands extend into the dermis

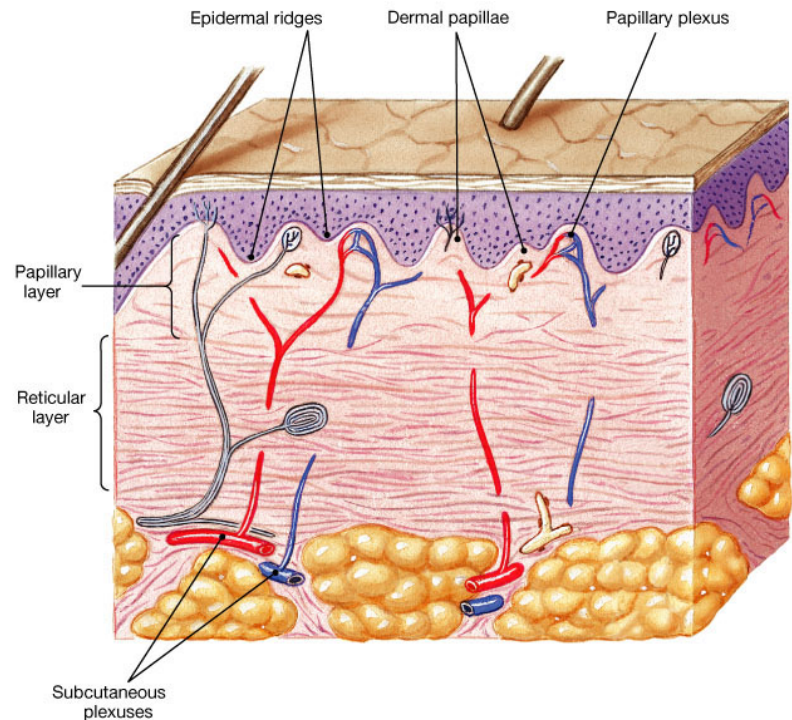
Dermis cont.

- Lines of cleavage – most collagen & elastic fibers arranged in parallel bundles along stress lines
- Important clinically as cuts parallel to lines of cleavage heal faster with less scarring



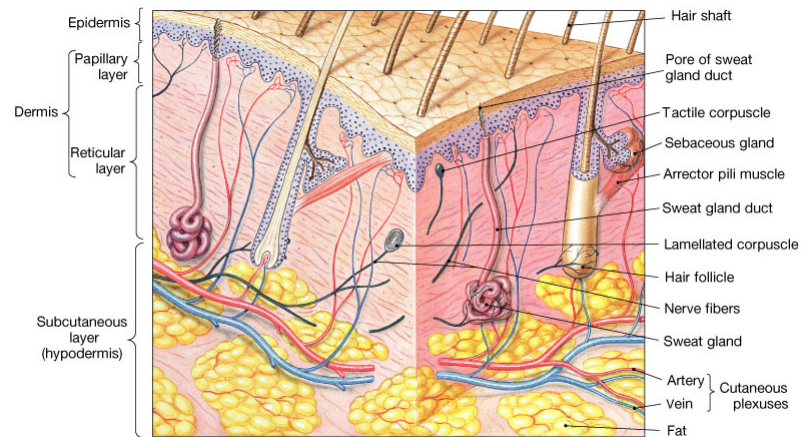
Dermal Circulation & Innervation

- Arteries in subcutaneous plexus in subcutaneous layer of skin along border with reticular layer of dermis send branches to papillary plexus in dermal papillae while supplying hair follicles, sweat glands, other structures in dermis



Dermal Circulation & Innervation cont.

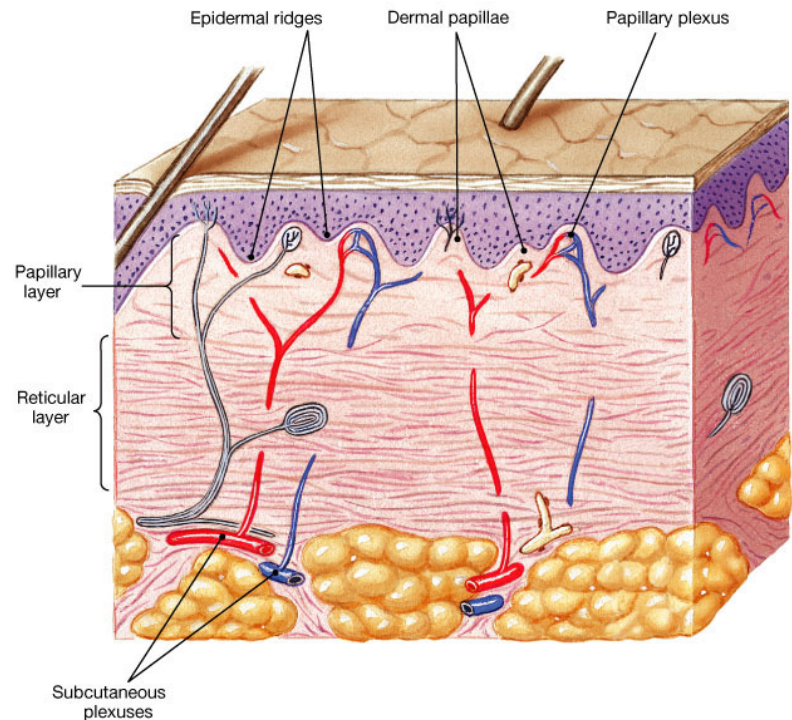
- Skin filled with sensory receptors controlling blood flow, adjusting gland secretions, monitoring receptors in skin
- Tactile corpuscles in dermal papillae to deep pressure lamellated corpuscles in reticular layer



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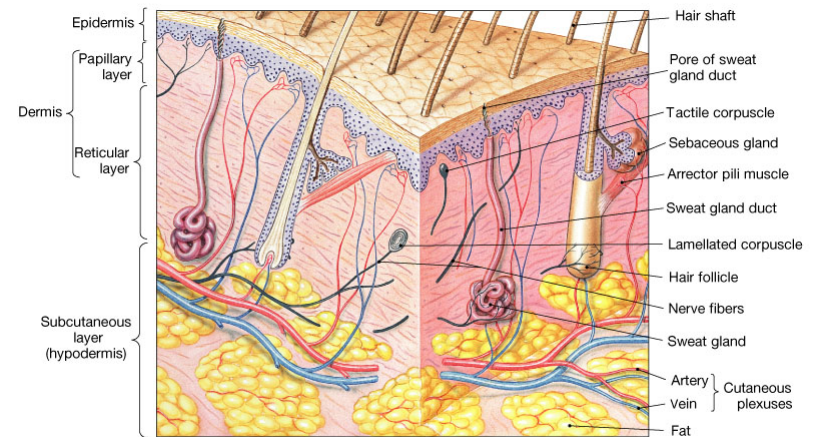
Subcutaneous Layer

- CT fibers of reticular layer of dermis interwoven with fibers of hypodermis
- Hypodermis helps stabilize skin in relation to underlying tissues
- Consists of areolar & adipose tissues & is elastic & contains lots of veins so called blood reservoir
- No major organs present so use a hypodermic needle for drug injection



Accessory Structures

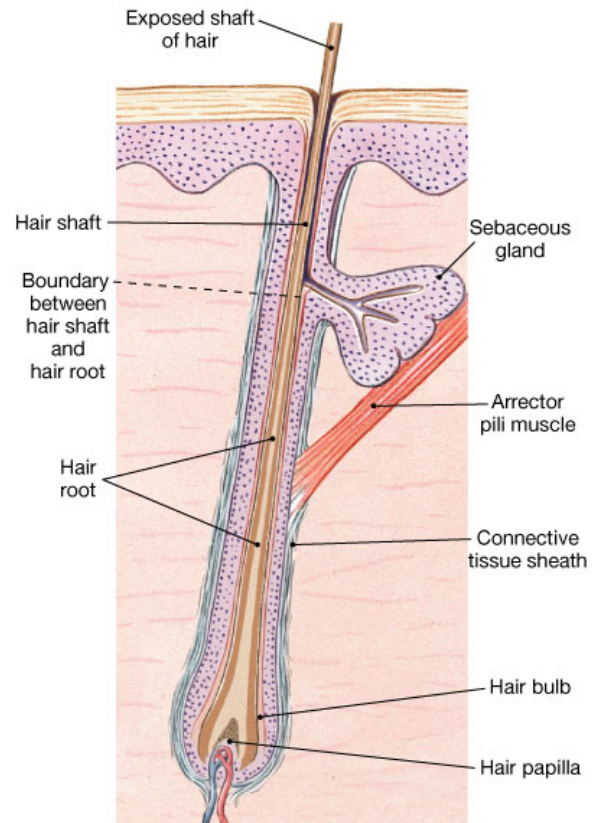
- Hair follicles, sebaceous glands, sweat glands, nails
- All originate from epidermis during development



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Hair Follicles & Hair

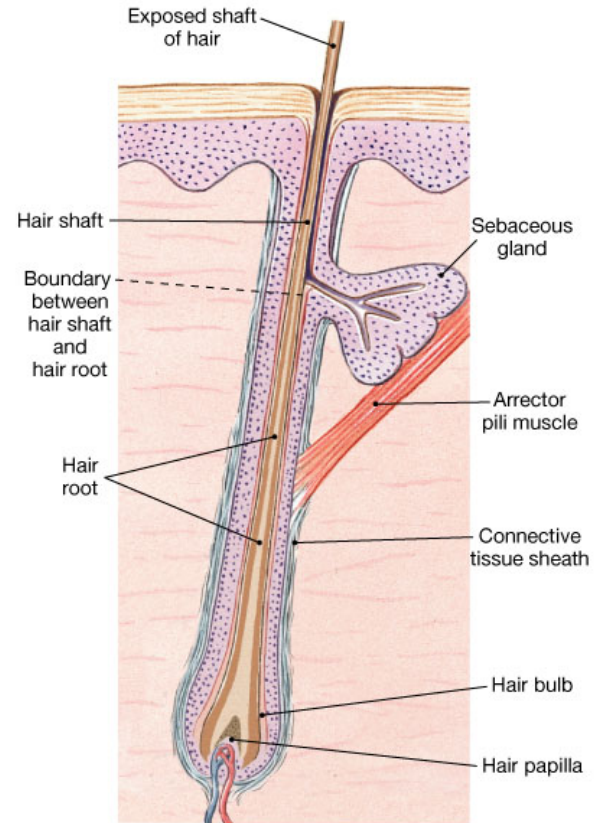
- Almost everywhere with 75% on general body surface , not head
- Hairs – nonliving structures produced in organs called hair follicles



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Hair Follicle & Hair cont.

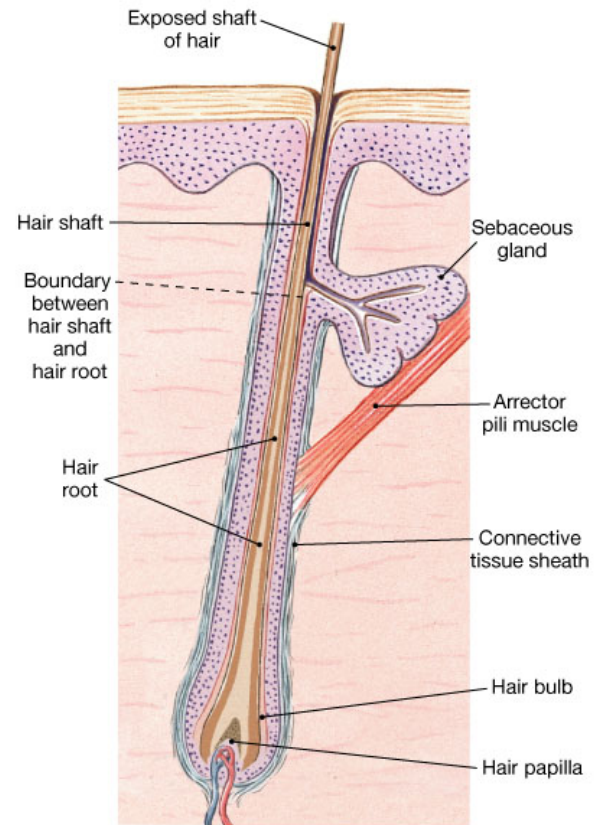
- Cuticle consists of outer layer of overlapping dead keratinized cells
- Cortex is intermediate layer & has hard keratin as does cuticle
- Medulla is inner layer of soft keratin



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Hair Follicle & Hair cont.

- Hair follicles which produce hairs extend into hypodermis & at the base have peg of CT containing capillaries & nerves - structure called hair papilla
- Hair bulb consists of epithelial cells surrounding hair papilla



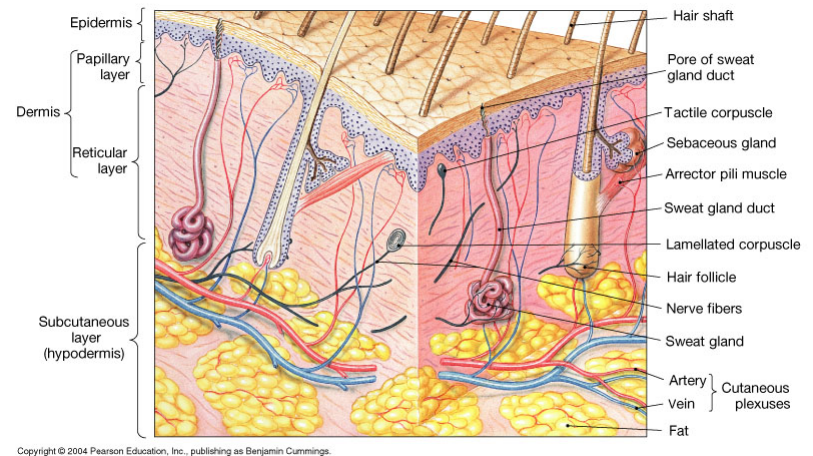
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Types of Hair & Hair Color

- Vellus hair – peach fuzz – over much of body
- Terminal hairs – heavy, more deeply pigmented, sometimes curly
- Melanocytes at the papilla produce pigments – genetically determined but environment plays a role – white hair due to lack of pigment & air bubbles in medulla of hair shaft

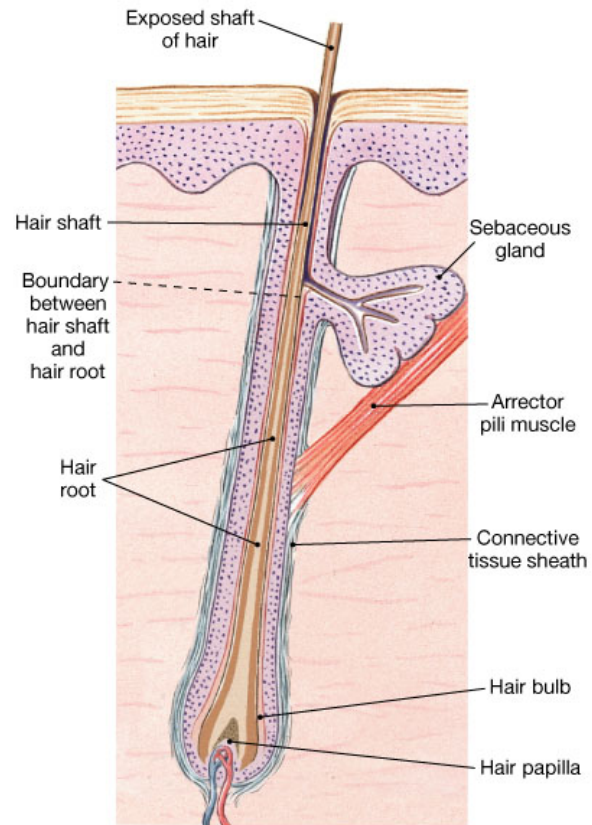
Functions of Hair

- Hairs on head protect against UV light & cushion a soft blow
- Hairs in nostrils & ear canal prevent entry of unwanted material
- Hair root plexus surrounds base of each hair & acts as a sensory receptor



Functions of Hair cont.

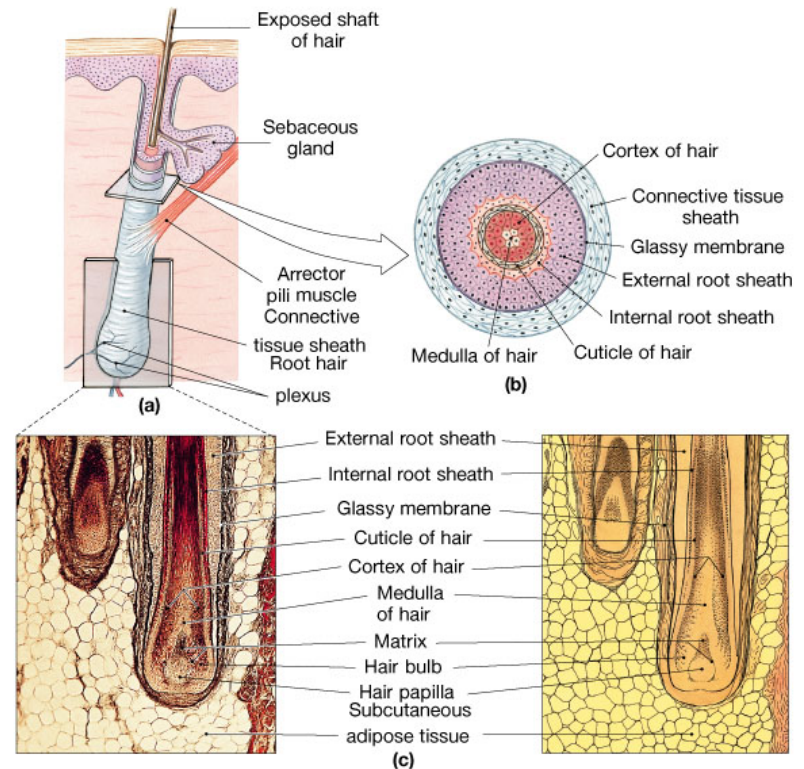
- Smooth muscle called arrector pili muscle extends from papillary dermis to hair follicle
- Contraction causes ‘goose bumps’



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Hair Production & Follicle Structure

- Deepest part of hair follicle has dividing basal cells in a region called hair matrix
- Cells in the matrix region start forming cuticle, cortex, medulla & cell division pushes cells upward & become keratinized as move away from papilla cells die

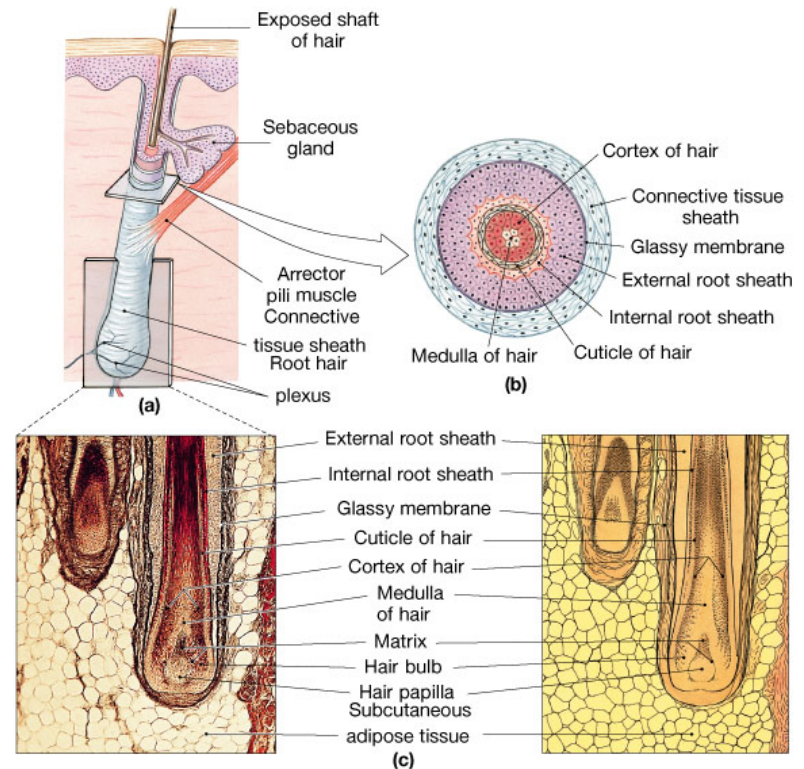


Hair Production & Follicle Structure cont.

- Epithelial cells of follicle wall organized into several layers
- Epithelial cells of follicle wall organized into several layers
- Internal root sheath – produced by cells of the periphery of hair matrix
- External root sheath – extends from skin surface to hair matrix & has most of cell layers found in superficial epidermis
- Glassy membrane – thickened basal lamina wrapped in dense CT

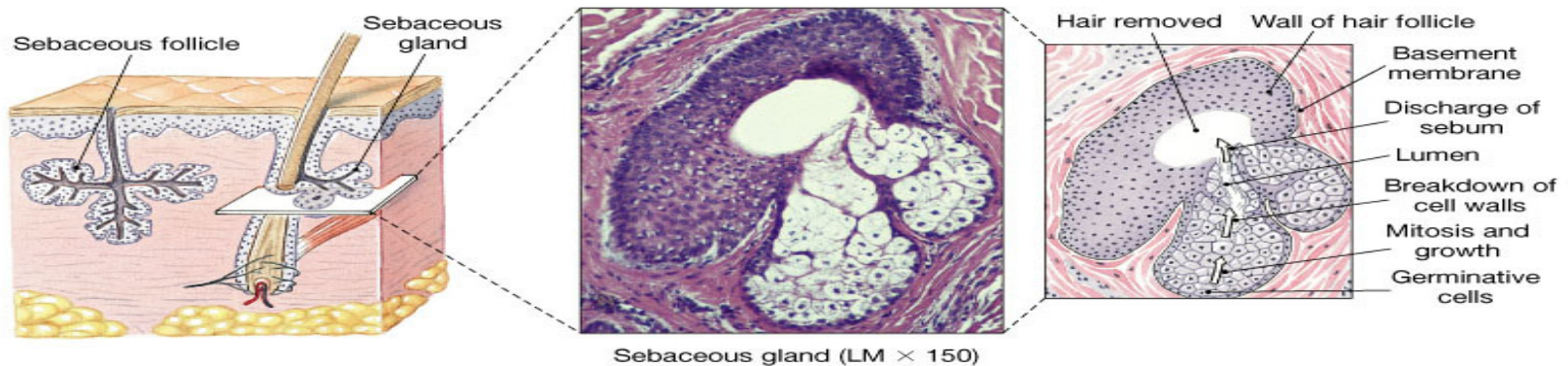
Hair Growth & Repair

- Hair growth cycle – on scalp hair lasts 2-5 yrs
- Healthy adults lose about 50 hairs/day
- Loss can increase due to drugs, dietary factors, radiation, excess vitamin A, high fever, hormonal changes
- Genetic changes called male pattern baldness affect hair loss



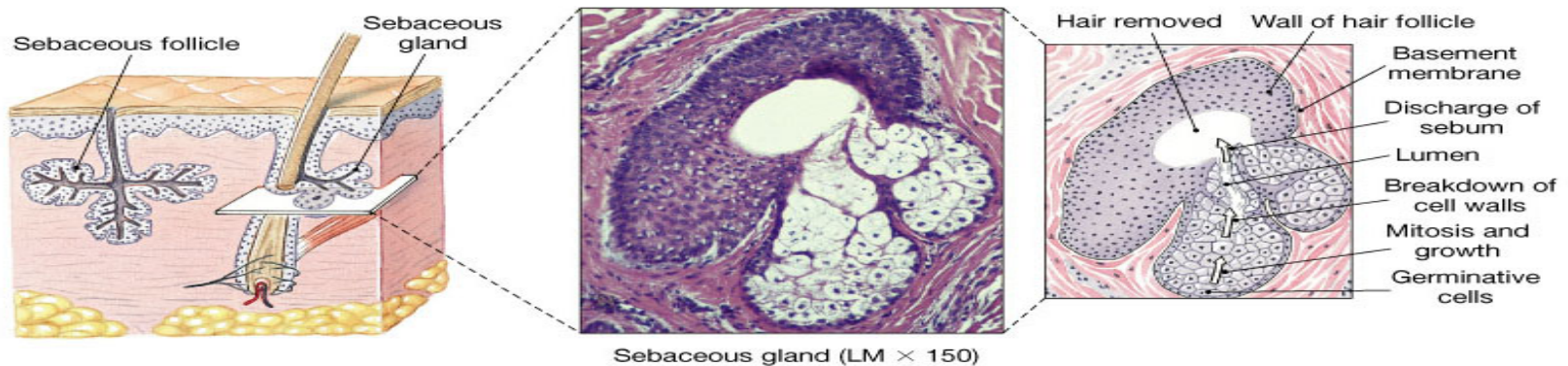
Glands of the Skin

- 1) sebaceous glands – holocrine glands that produce oily lipid that coats hair shafts & the epidermis secretion of lipid called sebum which is mix of triglycerides, cholesterol, proteins, & electrolytes



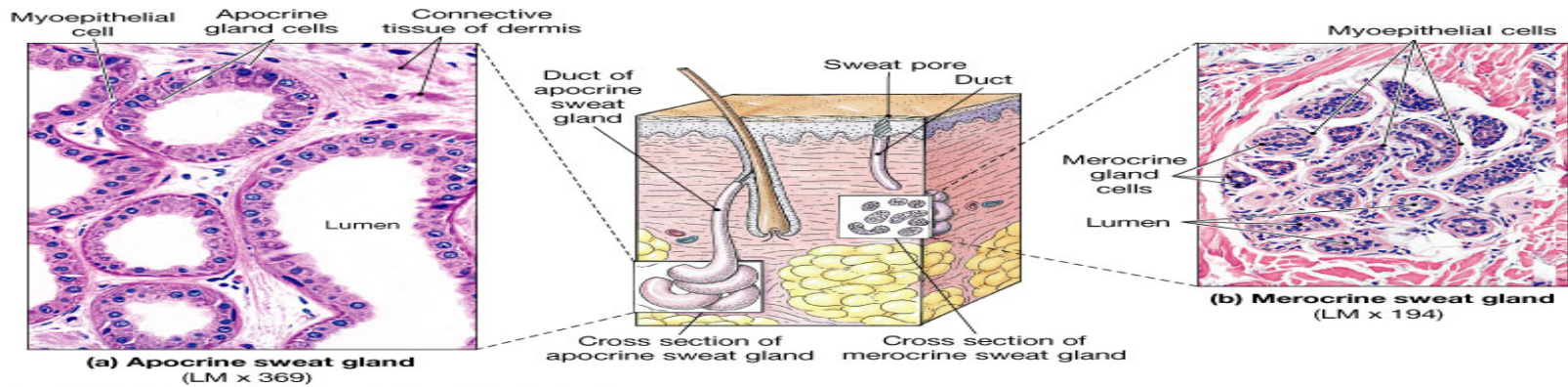
Glands of the Skin cont.

- Sebum inhibits growth of bacteria, lubricates & protects keratin of hair shaft, conditions surrounding skin
- Sebaceous follicles are large glands not associated with hair follicles & sebum discharged directly onto skin - located on face, back, chest, nipples, external genitals where activity increases at puberty



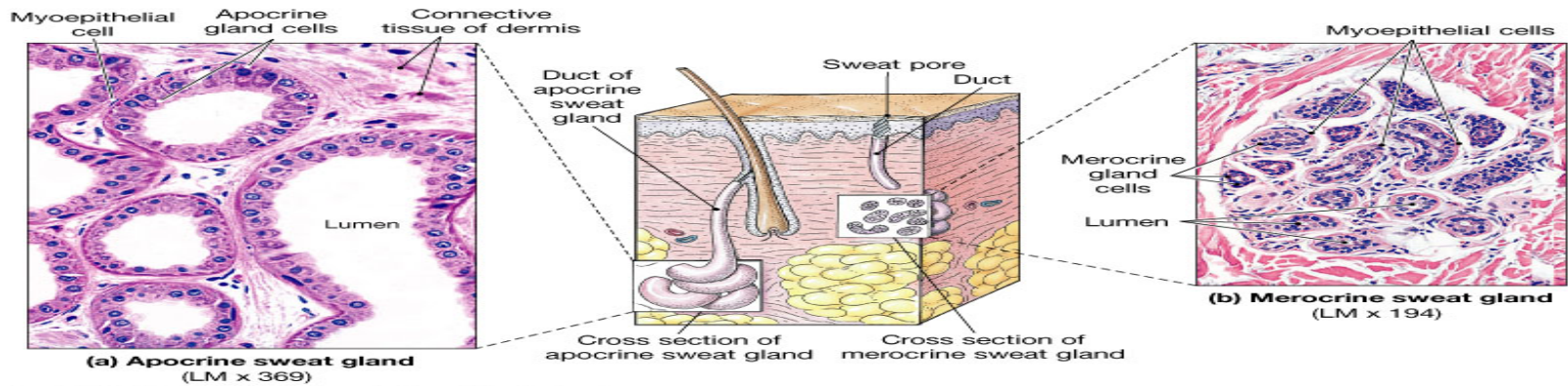
Glands of the Skin cont.

- 2) sweat glands – 2 types apocrine & eccrine or merocrine
- Apocrine glands in armpits, around nipples, in groin area secrete sticky, cloudy secretion starting at puberty secretion is a nutrient for bacteria which make the secretion odorous secretion of gland controlled by NS & by circulating hormones



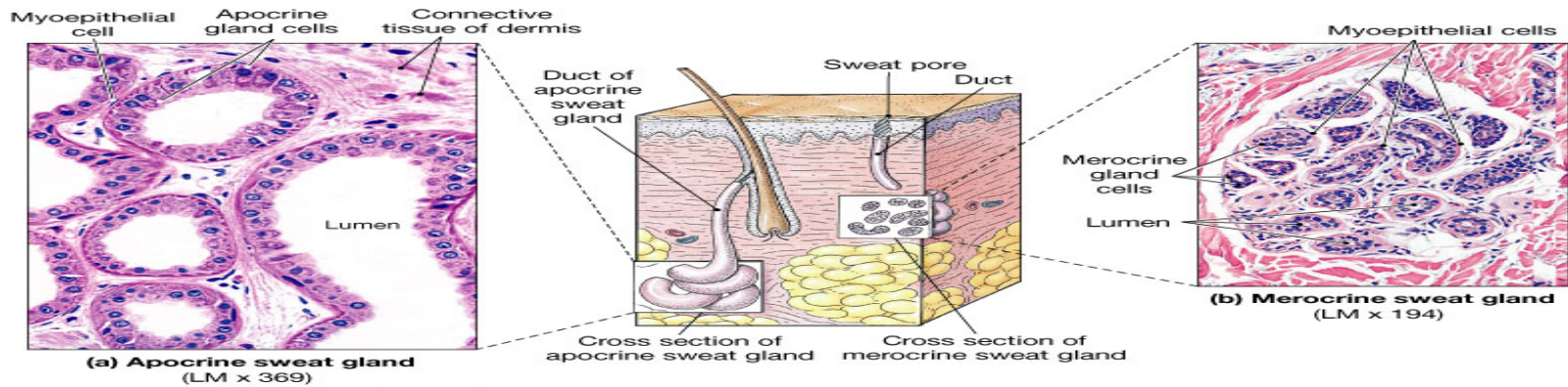
Glands of the Skin cont.

- Eccrine or merocrine glands – widely distributed (esp. palms & soles) secrete directly onto skin surface
- Sweat is 99% water plus electrolytes, organic nutrients, an antibiotic & waste products



Glands of the Skin cont.

- Functions of merocrine sweat glands include cooling skin surface to reduce body heat, excreting water & electrolytes, providing protection from environmental hazards

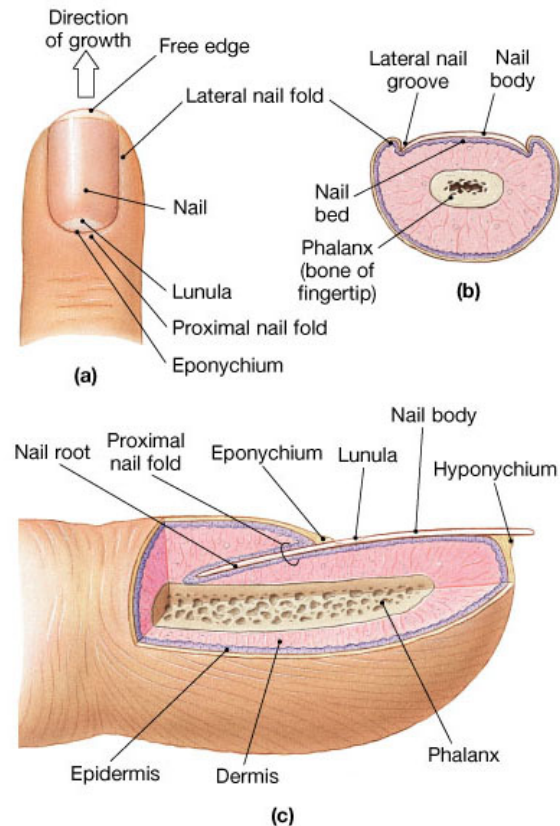


Glands of the Skin cont.

- Mammary glands – related to apocrine sweat glands but secrete milk
- Ceruminous glands of ear secrete cerumen or ear wax
- Sebaceous glands & apocrine sweat glands controlled by autonomic NS – all or none effect for each type
- Merocrine sweat glands controlled more precisely – not all or none

Nails

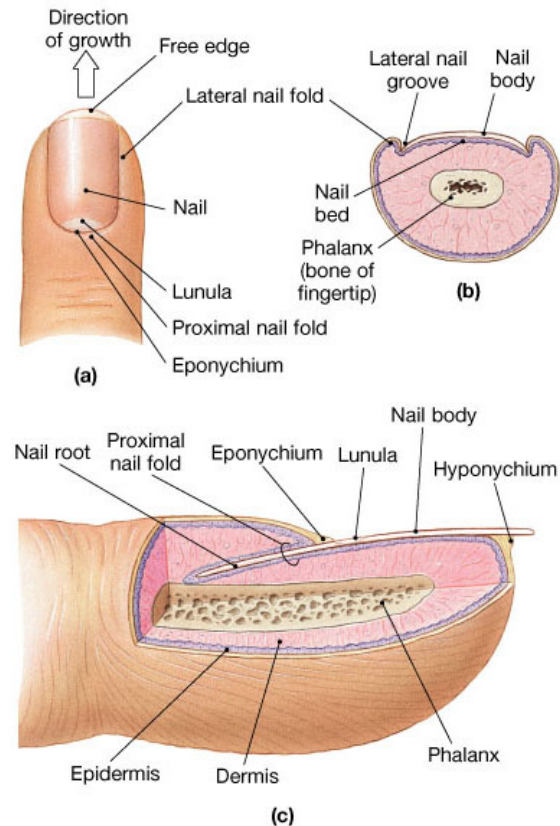
- Dorsal surface of tips of fingers & toes
- Nail body covers nail bed (epidermis)
- Free edge extends over hyponychium (thickened S. corneum)
- Production occurs at nail root & portion of S. corneum of nail root extends over exposed nail forming eponychium or cuticle



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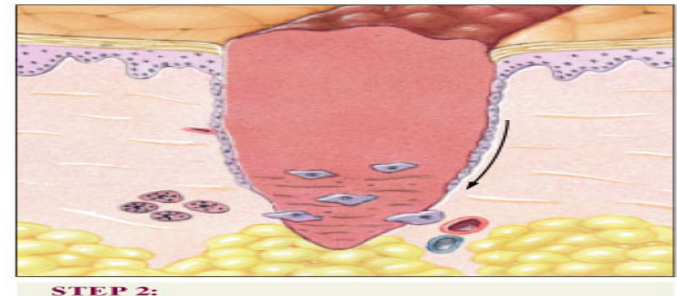
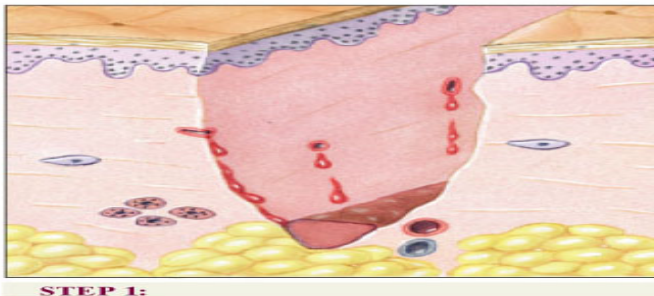
Nails cont.

- Under cuticle are blood vessels giving pink color except near root where lack of vessels gives pale crescent called lunula
- Body of nail consists of dead cells packed with keratin



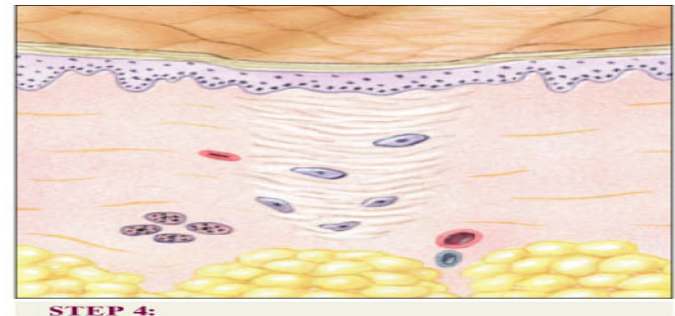
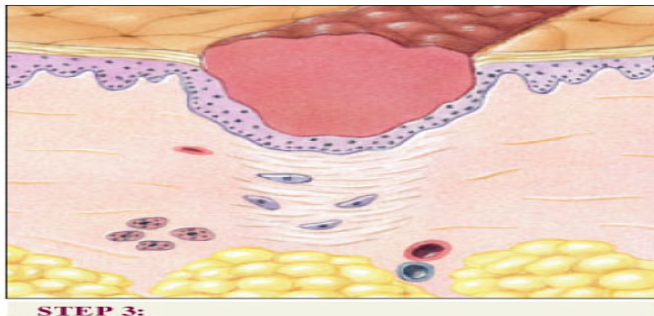
Injury & Repair

- 4 steps in regeneration of skin after injury
- 1) blood clot or scab occurs at injury site
- 2) clot mostly fibrin -end product of clotting – cells of S. basale divide & migrate along wound & macrophages clean up



Injury & Repair

- 3) fibroblast activity leads to appearance of collagen fibers & typical ground substance in dermis
- 4) fibrous tissue forms which lacks hair follicles, sweat glands, muscle cells, nerves



Burns

- Classified by degrees
- 1st degree – surface of epidermis affected – red & painful – sunburn
- 2nd degree – epidermis & some of dermis affected – blistering & pain – can heal if not infected
- 3rd degree – full thickness burns – less painful as nerve endings gone need grafts to repair
- 3rd degree covering >20% of body is critical as have fluid & electrolyte balance issues, thermoregulation issues, infection problems
- Rule of nines used to estimate amount of affected surface

Aging & Integumentary System

- Epidermis & dermis thin, vitamin D3 production declines, melanocyte activity declines, glandular activity declines, blood supply to dermis reduced & sweat glands less active, hair follicles stop functioning,

