Topic 2: THE INTEGUMENTARY SYSTEM

Chapter 5

2.1 Describe the layers of the epidermis

"Would you be enticed by an advertisement for a coat that is waterproof, stretchable, washable, and permanent-press, that automatically repairs small cuts, rips and burns? How about one that's guaranteed to last a lifetime?" (Marieb & Hoehn, intro to chapter 5)

Integumentary System = skin + derivatives (sweat & oil glands, hair, nails)

The Structure of Skin

- 2 distinct regions: ***epidermis*** (epithelial layer - thick, keratinized stratified squamous epithelium) and ***dermis*** (CT)

1. Epidermal cells (4 types):

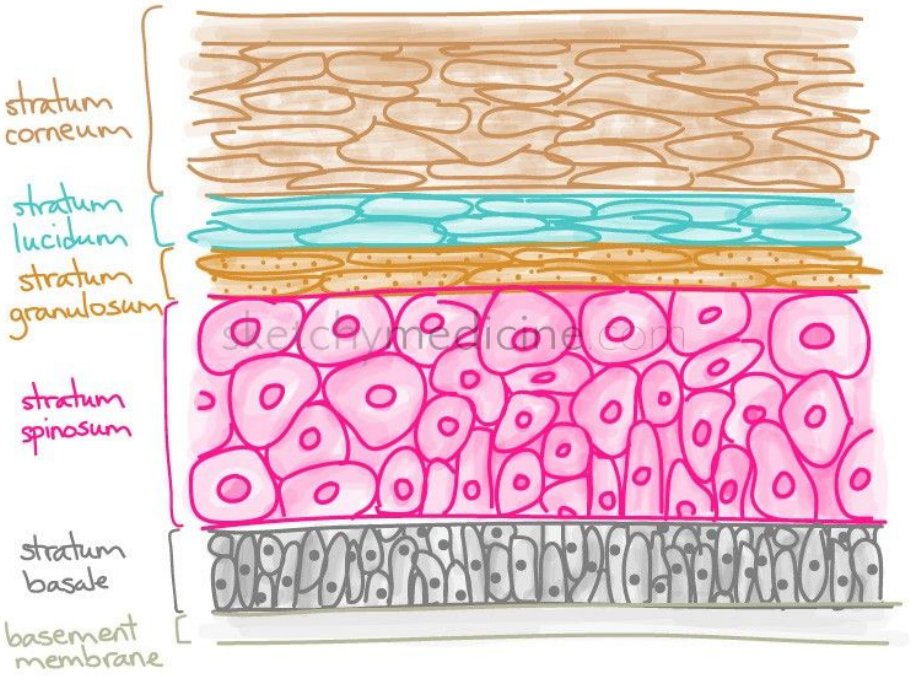
(1) Keratinocytes:

What is the main function of a keratinocyte?

to make keratin, provide physical structure of epidermis

What is the lifespan of a keratinocyte?

25-45 days, depends on age, area of body



http://sketchymedicine.com/wp-content/uploads/2012/11/epidermis.jpg

(2) Melanocytes: produce melanin in the stratum basale; numerous branching processes for transfer of melanosomes to adjacent keratinocytes (*function??*)

What is the role of melanocytes in contributing to skins of different colour/tanning ability?

(3) Dendritic cells (Langerhans' cells): (star-shaped); migrate to epidermis from bone marrow; *macrophages* • activate immune system

(4) Tactile cells(Merkel cells): at epidermis/dermis boundary; have a disc-like sensory nerve ending - *touch receptors*

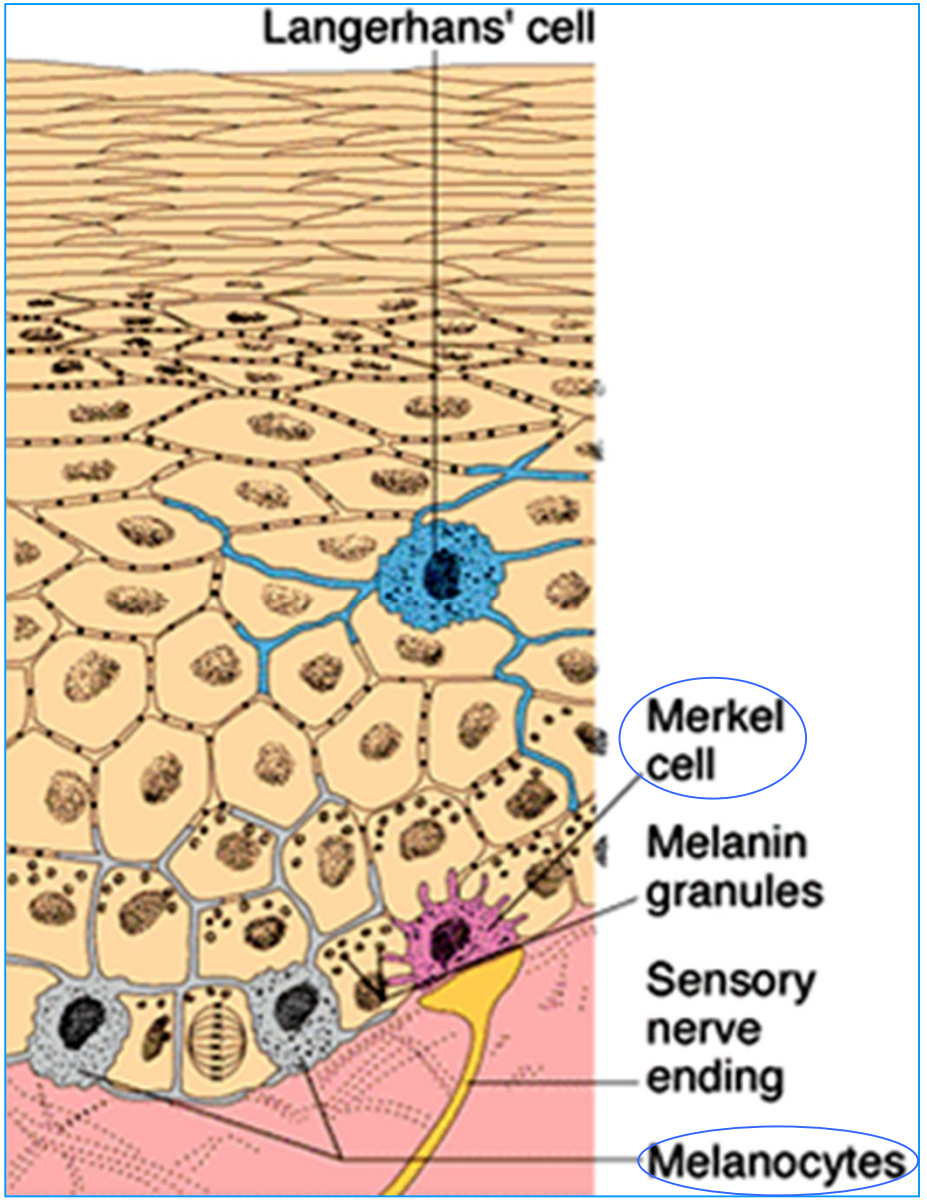
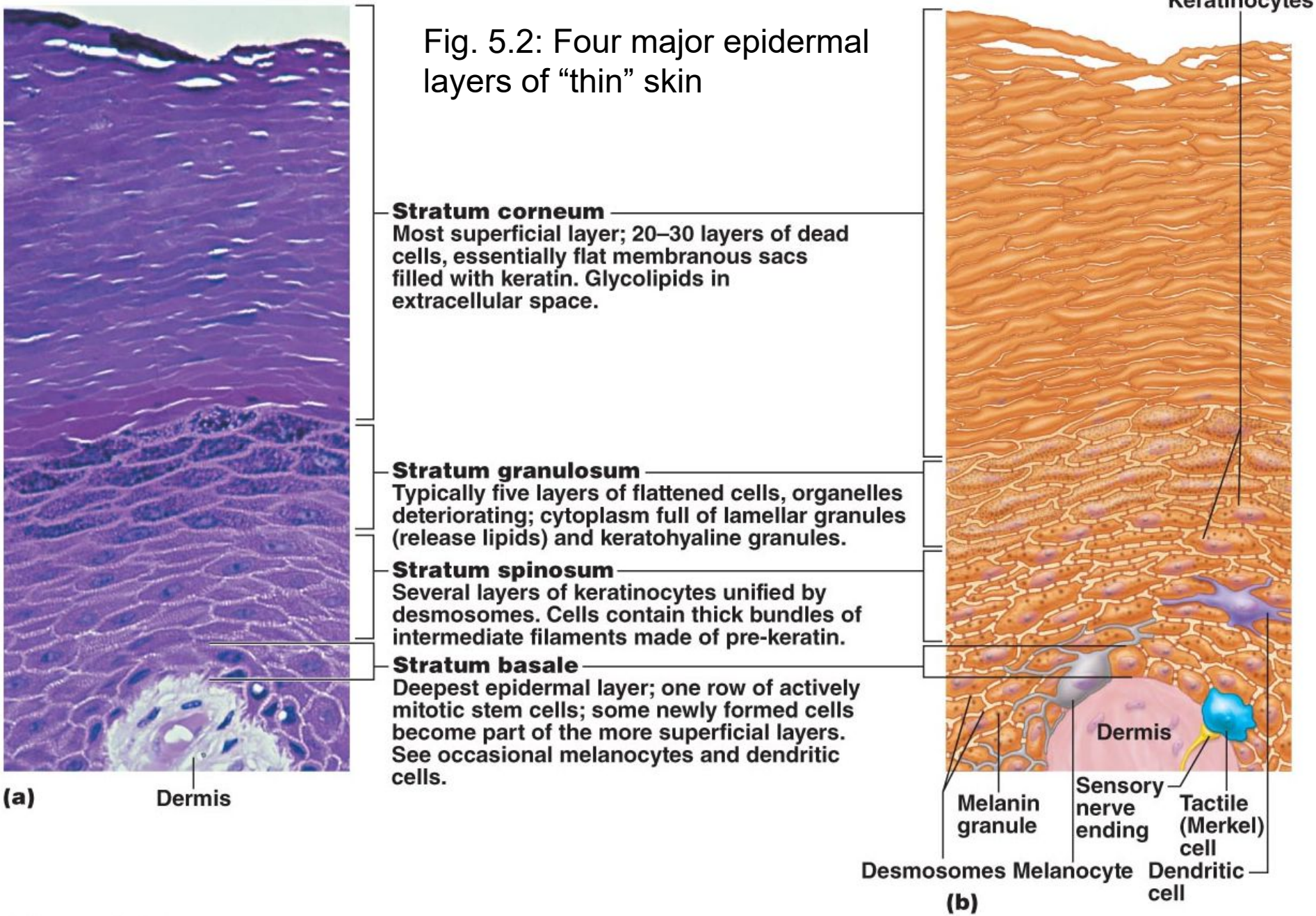


Fig. 5.2 (7th edition)

Fig. 5.2: Four major epidermal layers of “thin” skin



What is thick skin versus thin skin?

Which layer is found *only* in thick skin?

Stratum lucidum (clear layer) – just 2-3 rows of clear, flat, dead keratinocytes

stratum corneum

stratum lucidum

stratum granulosum

stratum spinosum

stratum basale

↓

DERMIS

2.2 Describe the layers of the dermis

cell types typical of CT: fibroblasts, macrophages, some mast cells, white blood cells

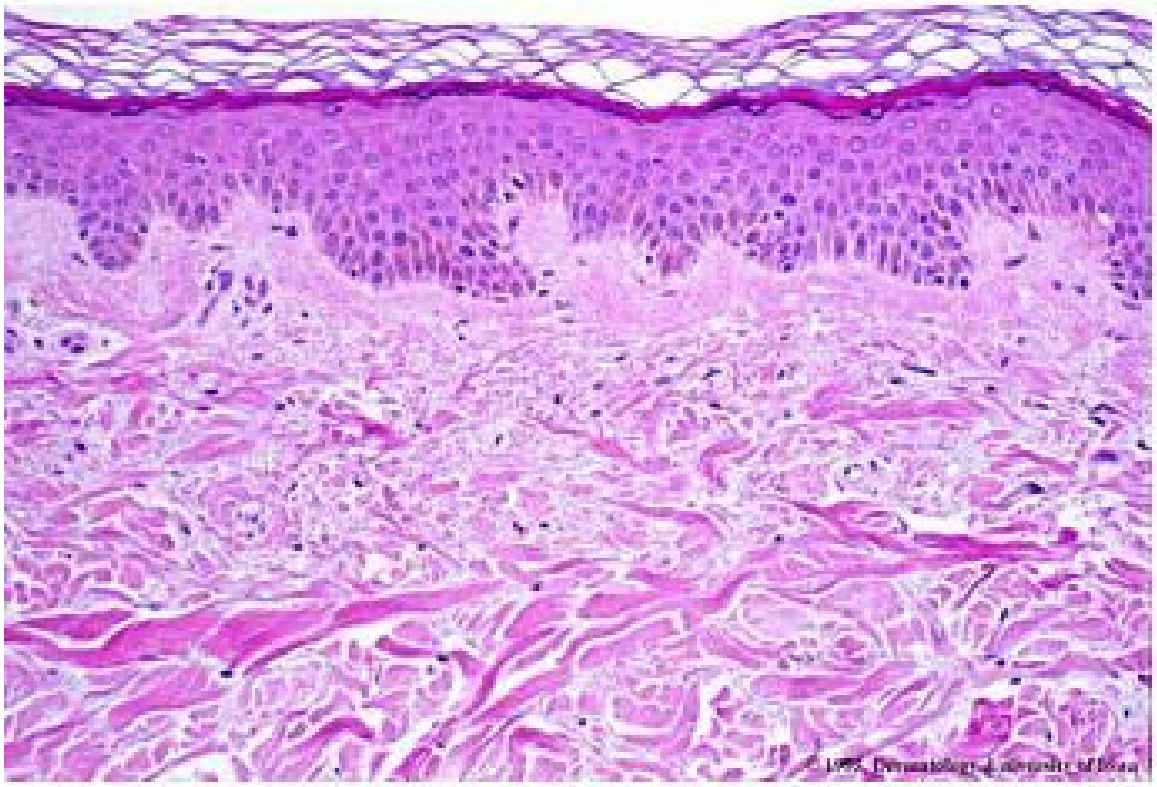
semi-fluid matrix heavily embedded with collagen, elastin & reticular fibers

richly supplied with nerve fibers, blood & lymphatic vessels

also hair follicles, oil & sweat glands

thin, superficial papillary layer

deeper, thick reticular layer



http://www.knowyourbody.net/papillary-dermis.html

Papillary layer:

interwoven mat of areolar CT fibers interspersed with blood vessels

dermal papillae (contain capillaries & nerve endings for touch, pain) indent overlying epidermis

on palms of hands, soles of feet, dermal papillae overlie dermal ridges to give us epidermal ridges known as friction ridges

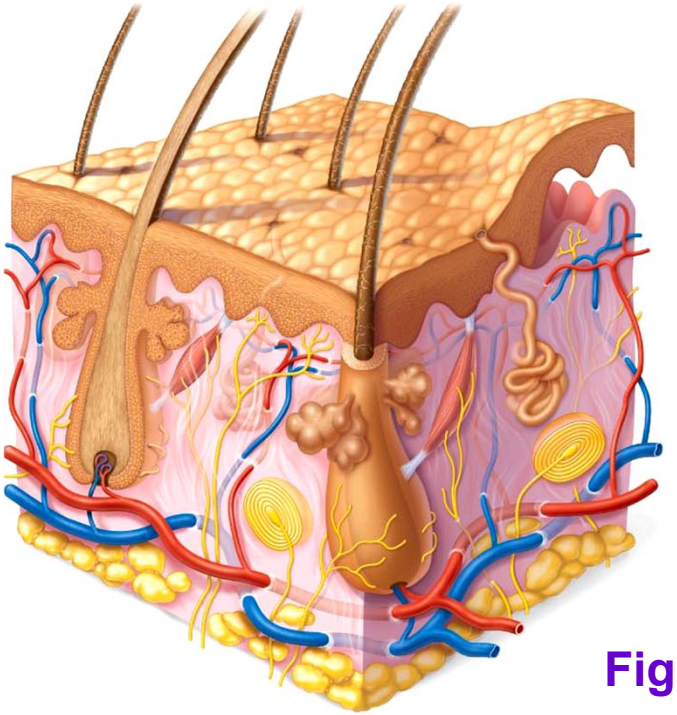
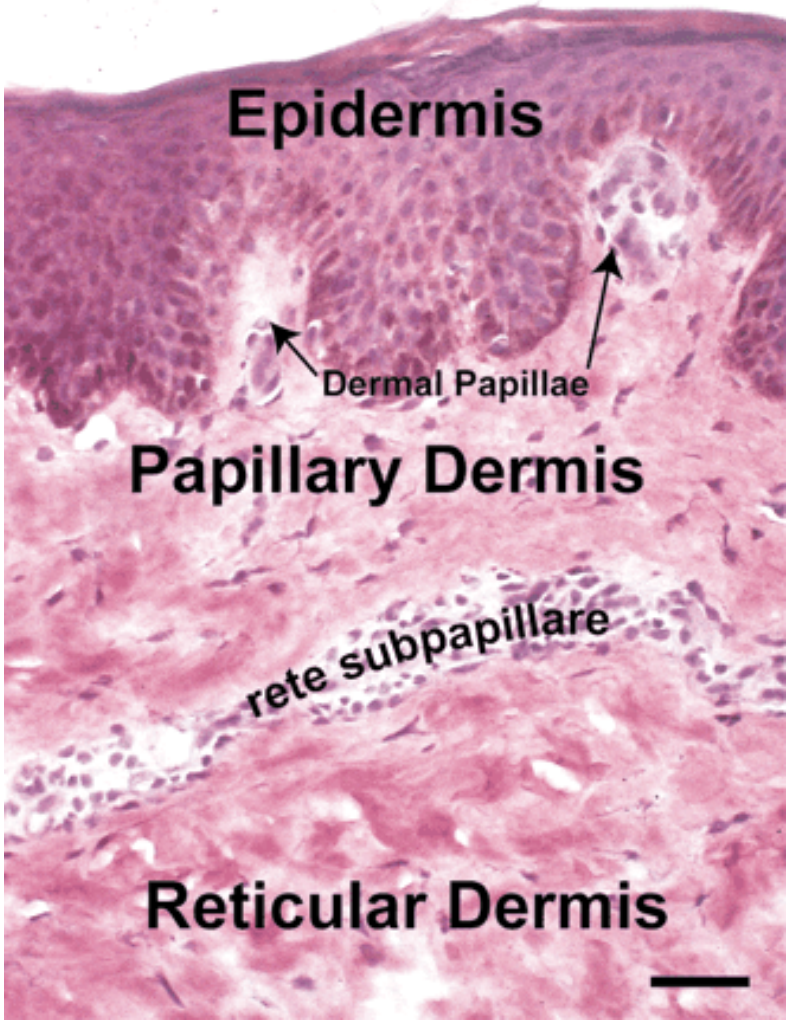


Fig. 5.1



http://www.knowyourbody.net/papillary-dermis.html

DERMAL RIDGES CAN BE MEASURED AND DESCRIBED DUE TO PHYSICAL PROPERTIES OF:

POSITION : Points of beginning to termination
CONFIGURATION : Parallel, cluster, tri-radius
QUANTITY : Ridge count per square centimeter
PROPORTION : Shape due to height, breadth, length
DURABLITIY : Permanent endocrine structures

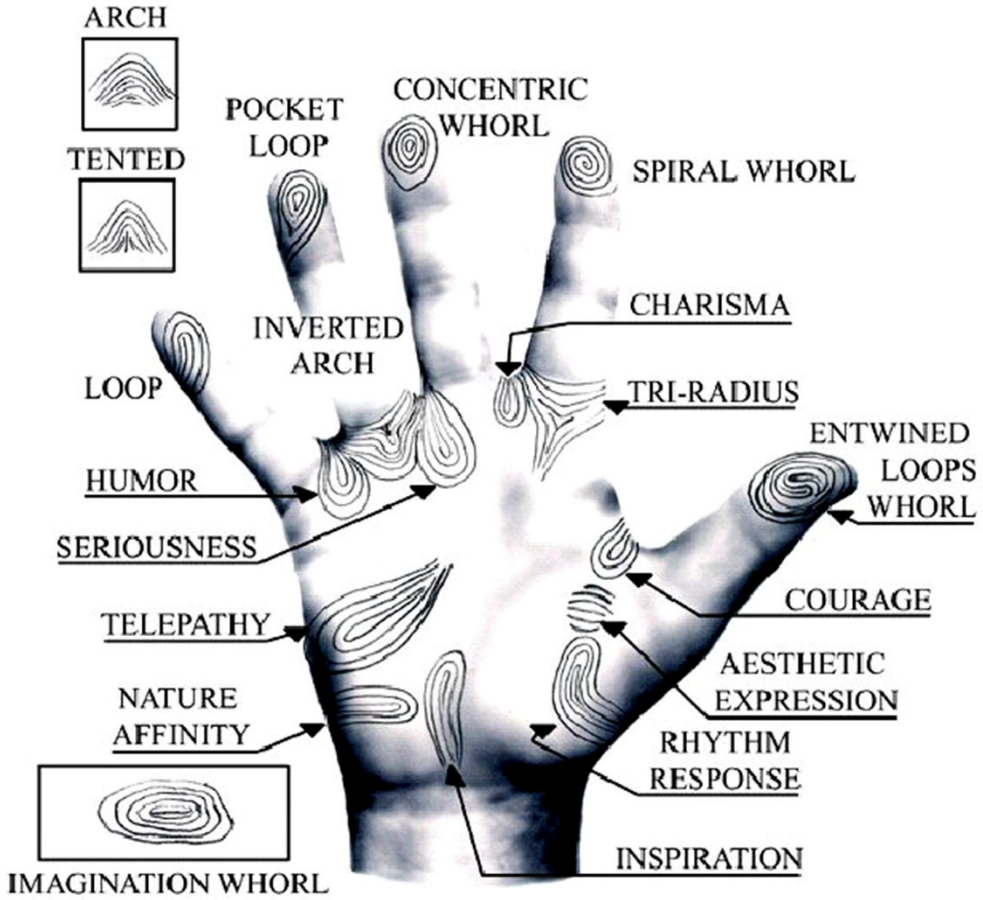


Diagram 1.

DERMAL RIDGE CONFIGURATIONS

Some Theoretical Meanings Suggested by Beryl Hutchinson, 1967

Reticular layer:

dense irregular CT (thick bundles of collagen fibers parallel to skin surface)

source of lines of cleavage (tension) lines

collagen fibers give strength & resiliency & maintain skin hydration; elastic fibers provide stretch-recoil

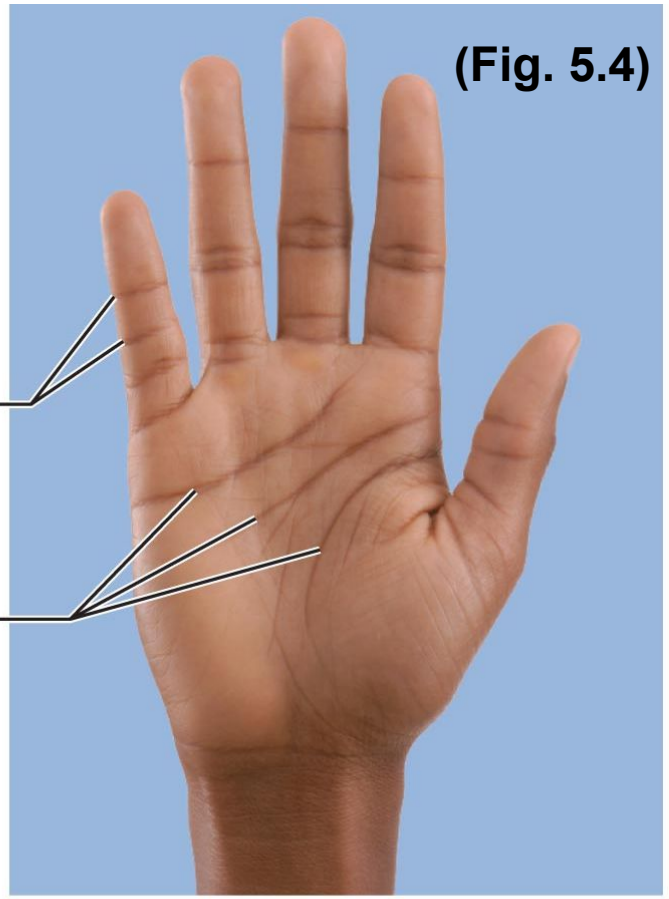
Fig. 5.4

(b) Cleavage lines in the reticular dermis

*What is the physiological basis of stretch marks or **striae**?*

*What happens when you get a **blister**?*

*What are **flexure lines** and where are they typically found?*



(c) Flexure lines of the hand

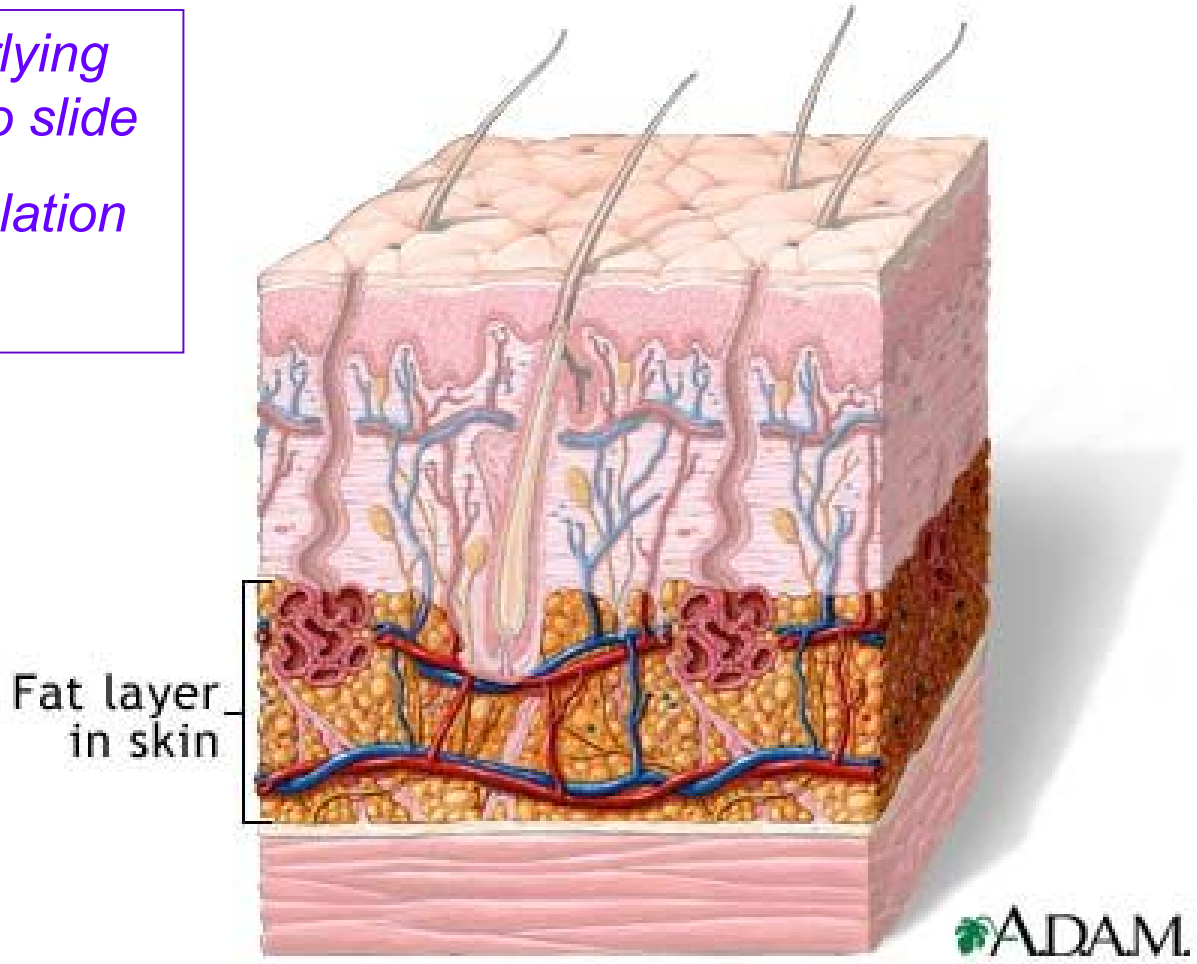
What is the hypodermis?

- superficial fascia, subcutaneous tissue
- areolar CT with blood vessels & adipose tissue

anchors skin to underlying structures with ability to slide

shock absorber & insulation

stores fat



http://www.umm.edu/imagepages/19490.htm

B. The Three Pigments Contributing to Skin Colour

melanin: only pigment of the 3 made in the skin; several different forms which give colours of yellow, rust, brown, black: skin colour dependent on type, relative amount and keratinocyte retention of the pigment

What damage does sun do to the skin & where does melanin figure into this?

carotene: yellow to orange pigment found in plant products - eg: carrots; deposits in keratinocytes (esp stratum corneum) & hypodermis

hemoglobin: from capillary circulation & gives skin a pinkish hue - *what is cyanosis?*

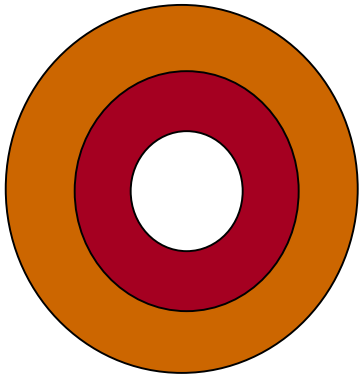
http://www.scf-online.com/english/32_e/frontpage32_e.htm

2.3 Describe the accessory structures of the skin

- hair follicles, hair, nails, sweat glands, sebaceous glands

1. Hairs & Hair Follicles

- functions of hair:
  - sense insects on skin
  - guard head
  - physical trauma, heat loss, sun
  - shield eyes, filter particles from inhaled air
- hard keratin (more durable, doesn't flake)



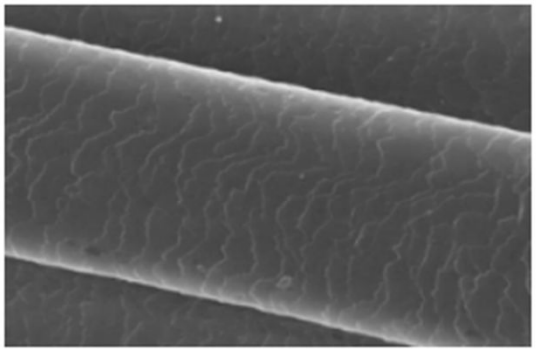
a) hair shaft

medulla: large cells separated by air spaces - absent in fine hairs

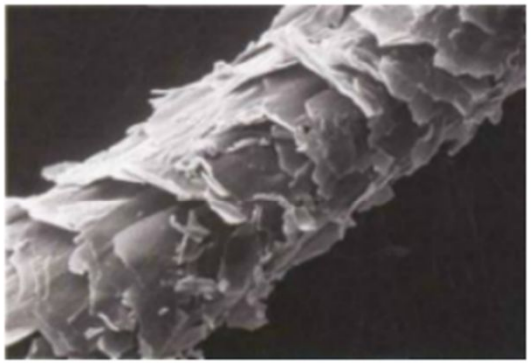
cortex: several layers of flattened keratinocytes; pigment is here

cuticle: single layer of overlapping cells

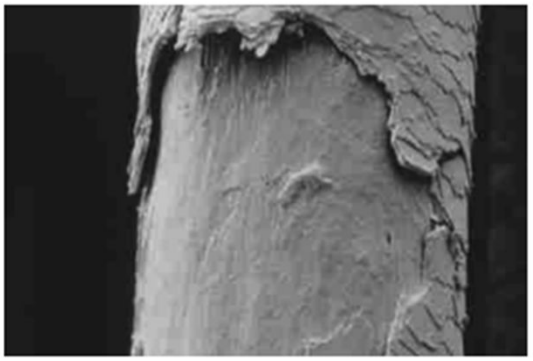
What are split ends?



Healthy Cuticle Layer

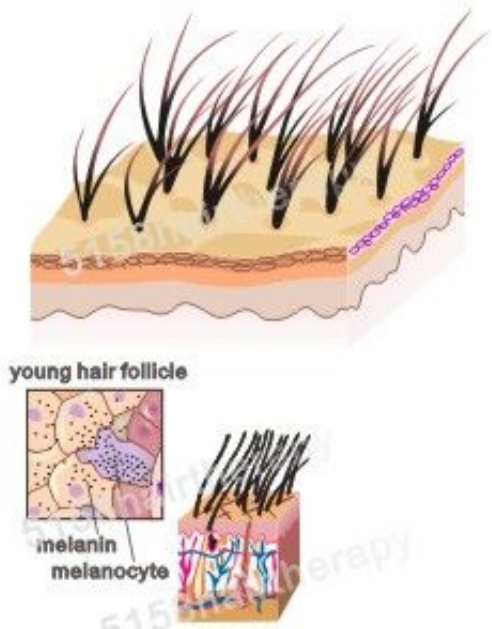


Raised Cuticle Layer



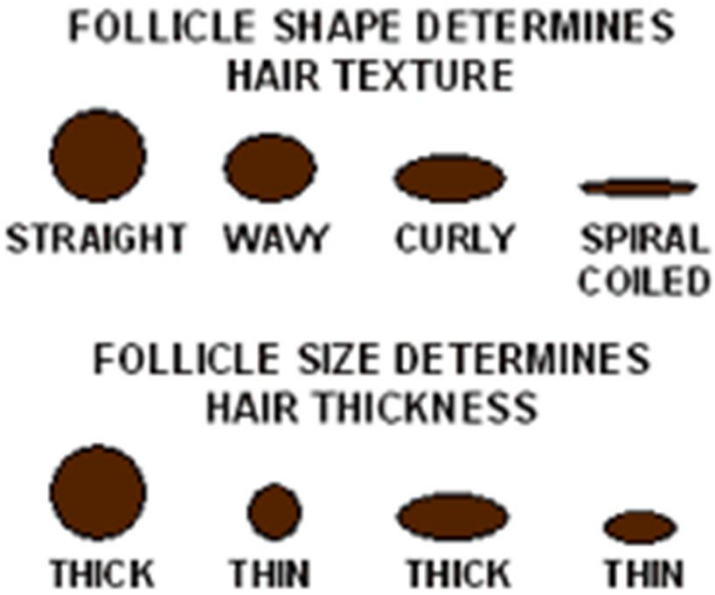
Damaged Cuticle Layer Missing Scales

What happens when hair is turning gray or white?



http://images.answerthis.co/image55d1b0ab8e94b.jpg

hair shaft - shape determines if hair is straight or curly



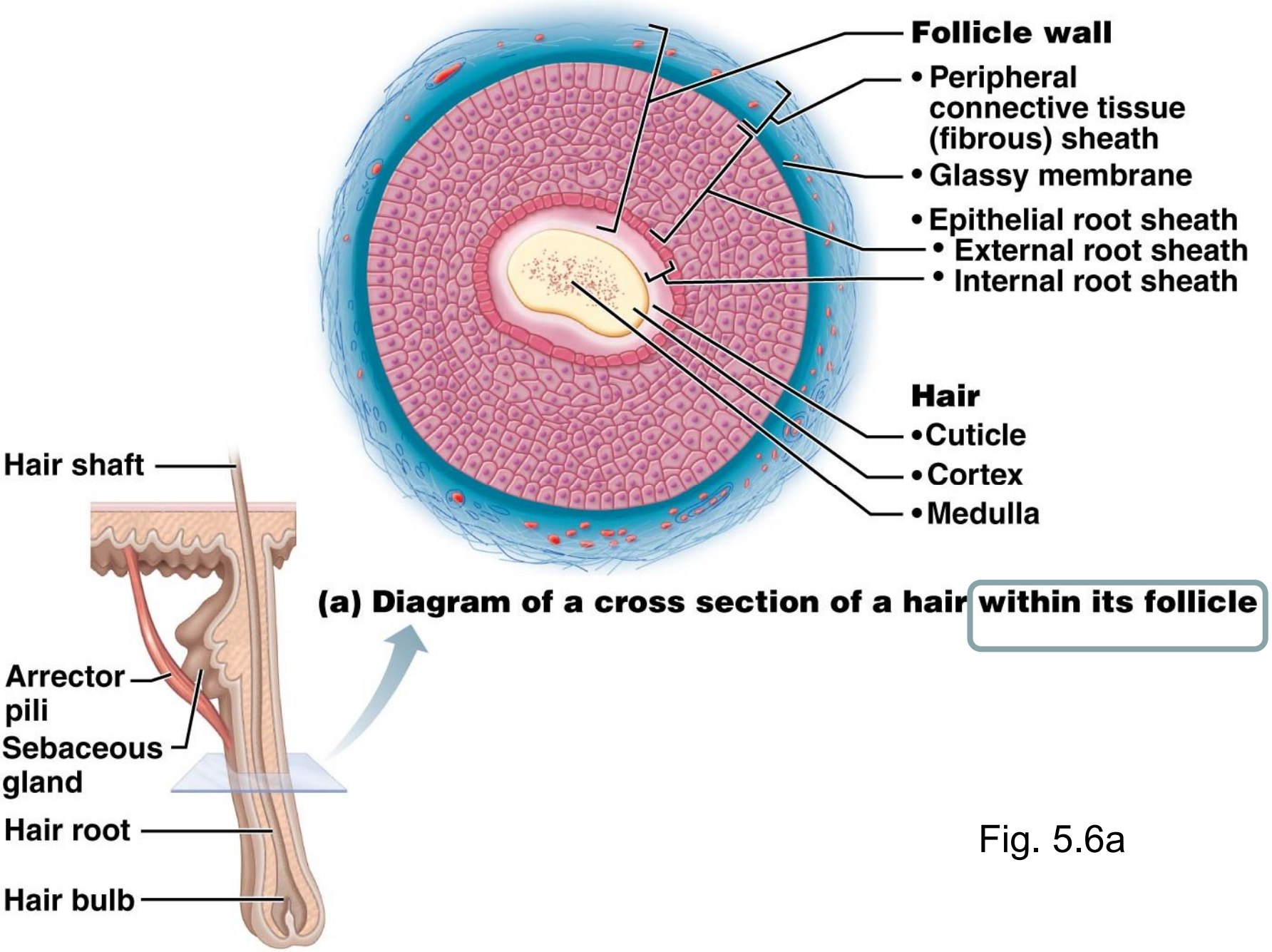
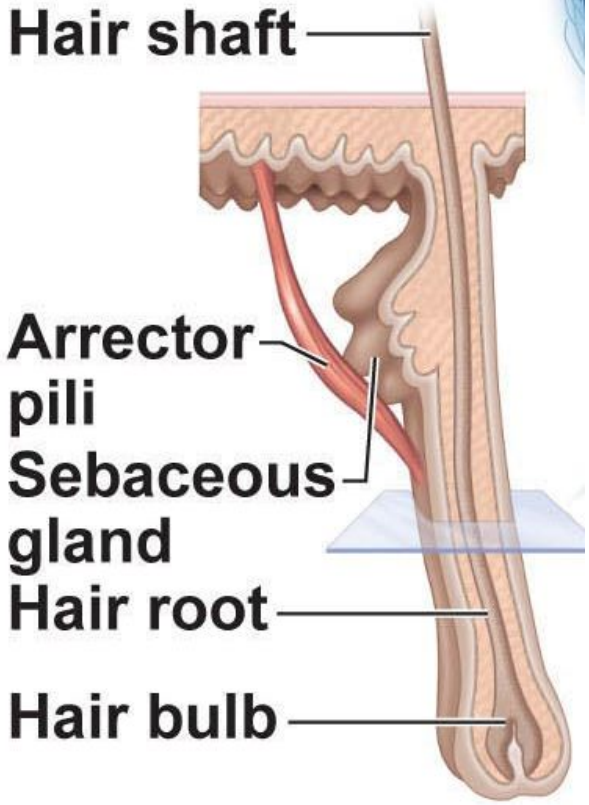


Fig. 5.6a

Fig. 5.6



b) <u>hair structure:</u>

shaft: part that projects from skin - has 3 layers indicated on previous slide

root: part embedded in skin (contained within hair follicle)

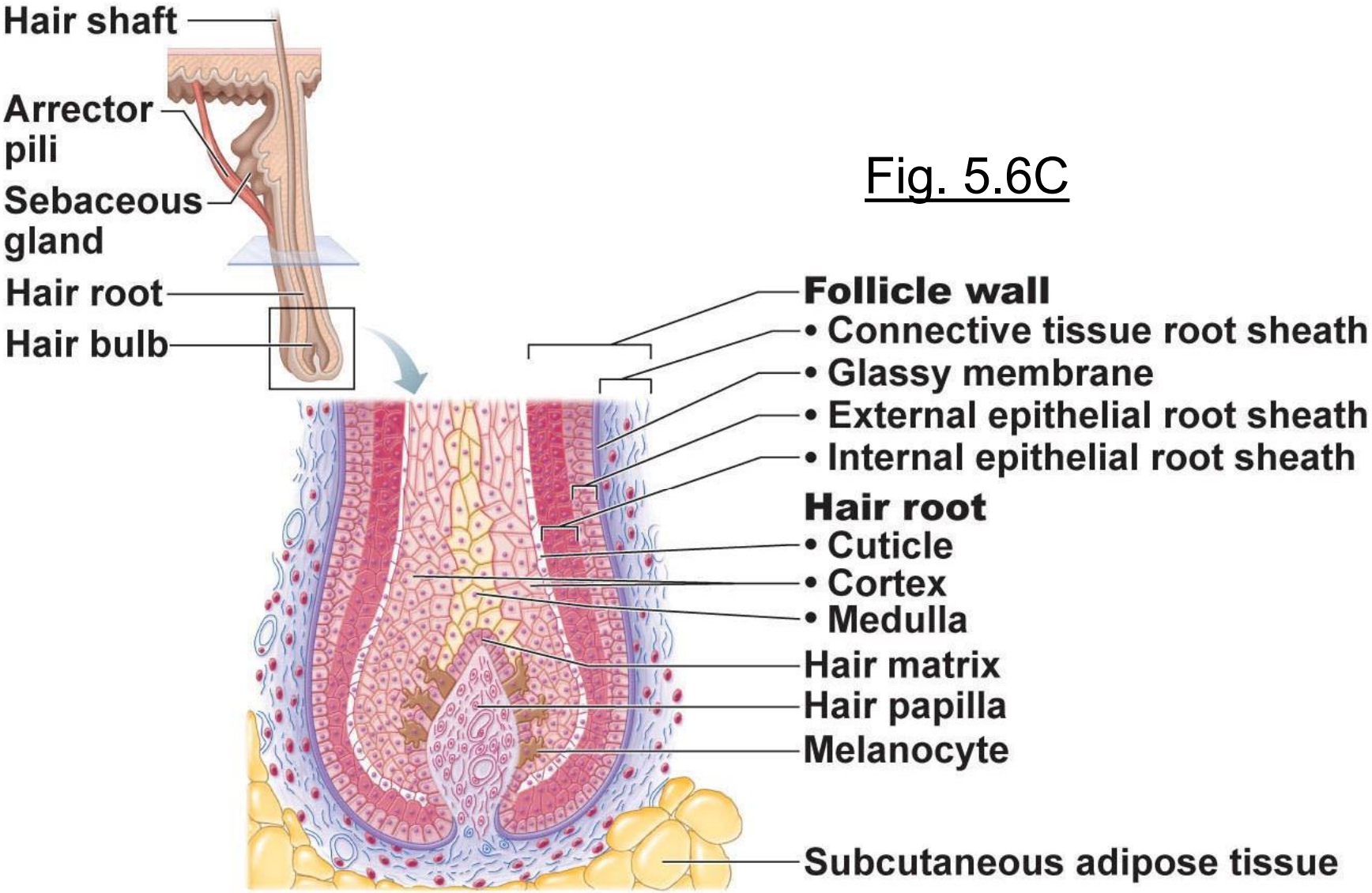
bulb: expanded deep end of follicle - has papilla & root hair plexus

follicle: outer CT root sheath & inner epithelial root sheath; hair matrix

arrector pili muscle: 1/follicle; contract to pull hair up & dimple skin

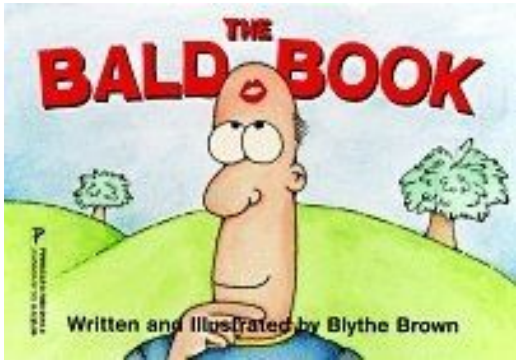
sebaceous gland: holocrine gland that secretes sebum (oily - lubrication & waterproofing; bactericidal)

Fig. 5.6C



(c) Diagram of a longitudinal view of the expanded hair bulb of the follicle, which encloses the matrix

Clinical Note: Hair Thinning & Baldness:



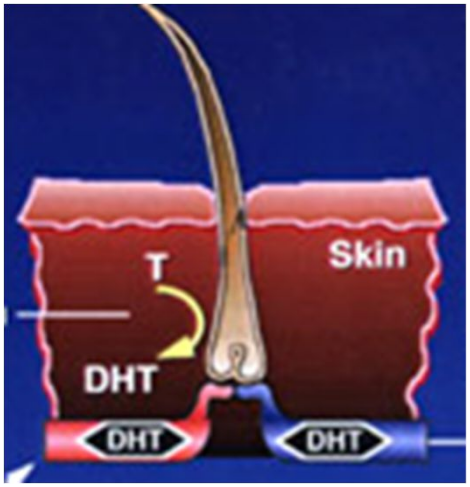
- vellus hair vs terminal hair
- hair growth is affected by hormones & nutrition

What is hirsutism?

- average rate of hair growth = ~2.5mm/week
- growth cycles: active growth phase • regressive/resting phase; however, each hair follicle has only a certain number of growth cycles before it is done

  which hair has longer active phase - eyebrow or head hair?

What is alopecia? What is male pattern baldness?

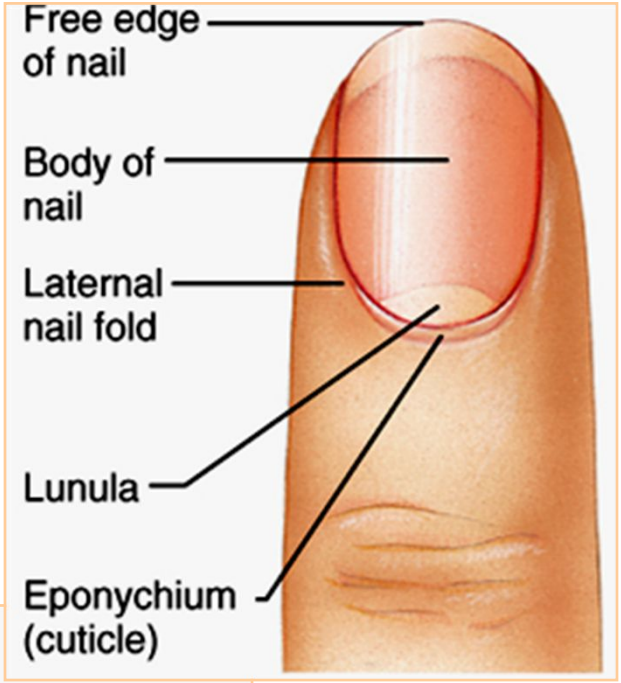


2. Nails:

scale-like modification of epidermis - protective, useful tool

free edge, body, nail folds - 2 lateral & 1 proximal

What is the lunula?



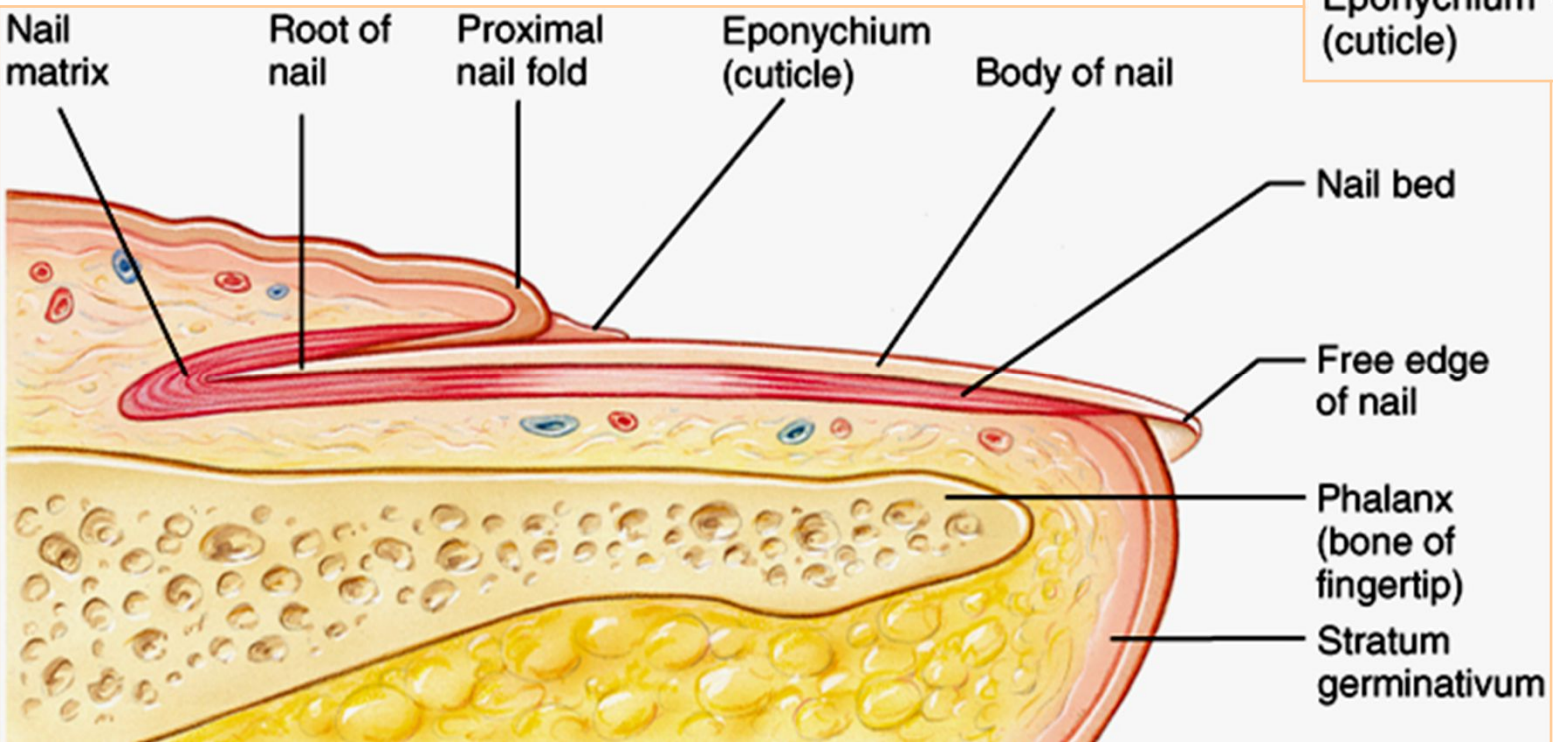
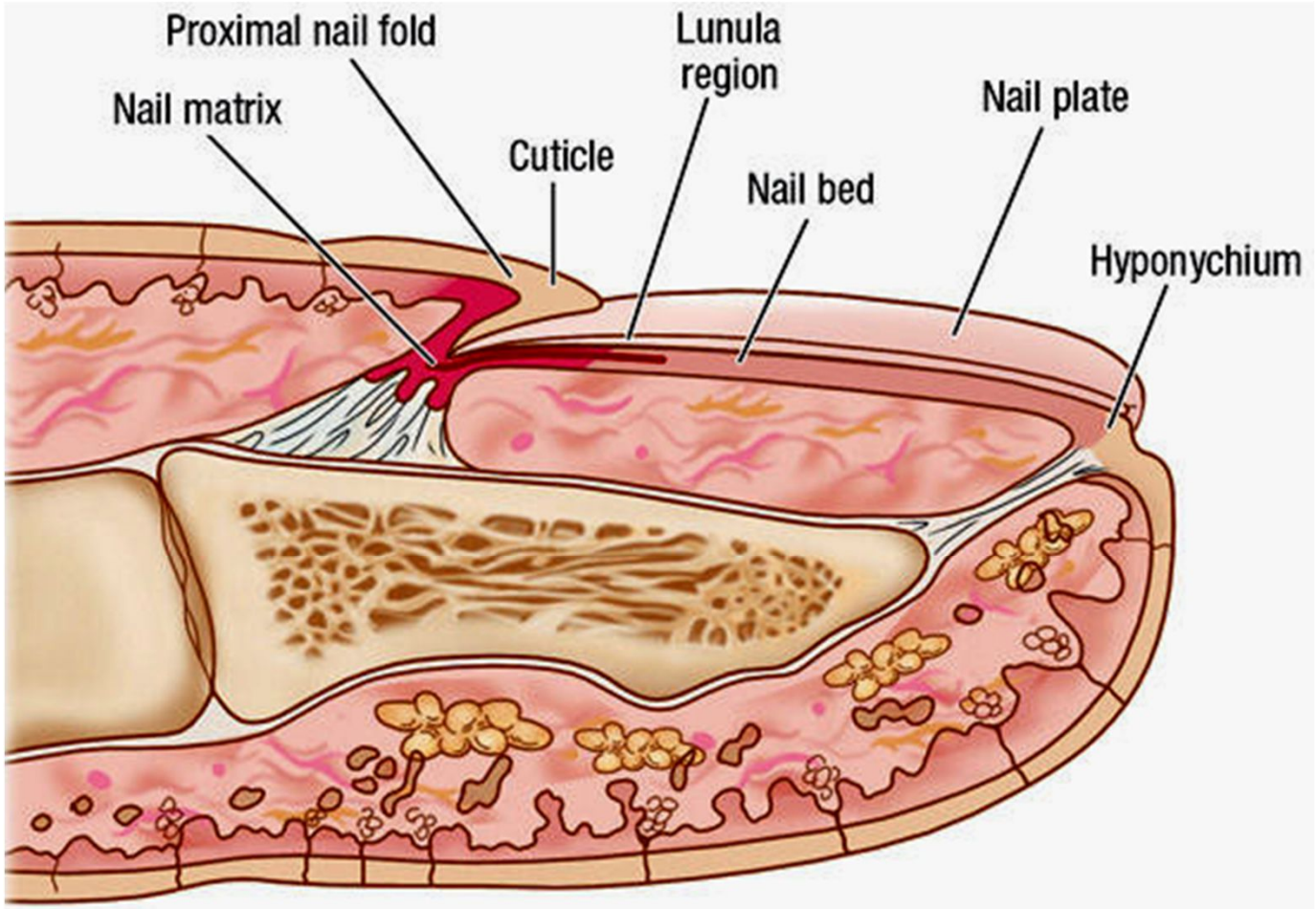


Fig. 5.7



Source: Wolff K, Goldsmith LA, Katz SI, Gilchrest BA, Paller AS, Leffell DJ: *Fitzpatrick's Dermatology in General Medicine*, 7th Edition: http://www.accessmedicine.com

The nail apparatus consists of a horny "dead" product, the nail plate, and four specialized epithelia: the proximal nail fold, the nail matrix, the nail bed, and the hyponychium. (http://histoweb.co.za/112/index.html)

Nails can provide some clues as to health status:

- **Yellow-tinged:** fungal infection or a serious respiratory or thyroid gland disorder
- **Thickened**: a fungal infection
- **Spoon nail:** possible iron deficiency
- **Beau's lines** (horizontal): malnutrition (sporadic stoppage of matrix growth)

http://www.webmd.com/skin-problems-and-treatments/ss/slideshow-nails-and-health

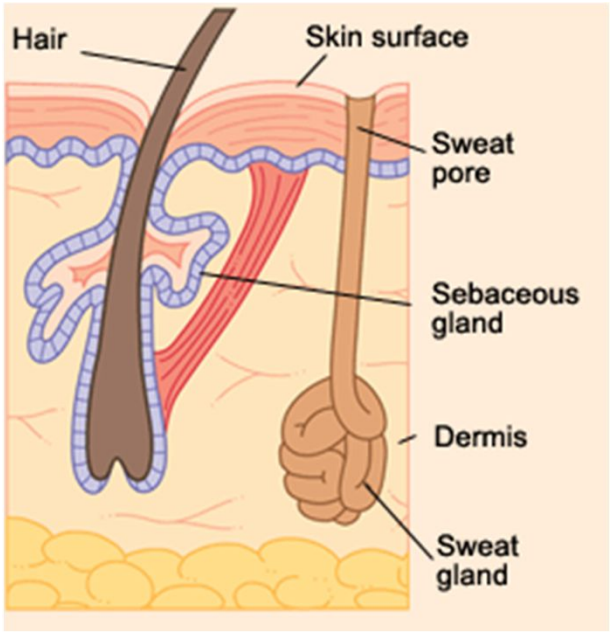
http://hardinmd.lib.uiowa.edu/dermnet/nails9.html

3. Sweat Glands (sudoriferous glands):

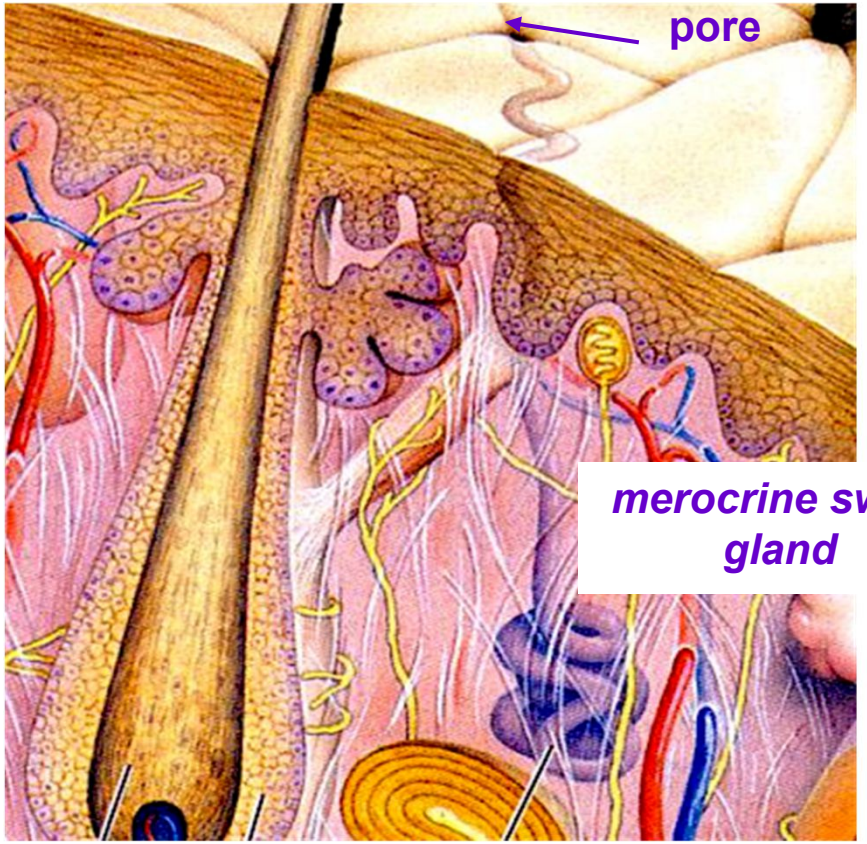
distributed over skin surface except nipples & parts of external genitalia- >2.5 million/person

(i) merocrine: more common; esp. palms, soles, forehead - simple coiled tubular glands with pore at surface

What is sweat??



J. Carnegie, UofO



merocrine sweat gland

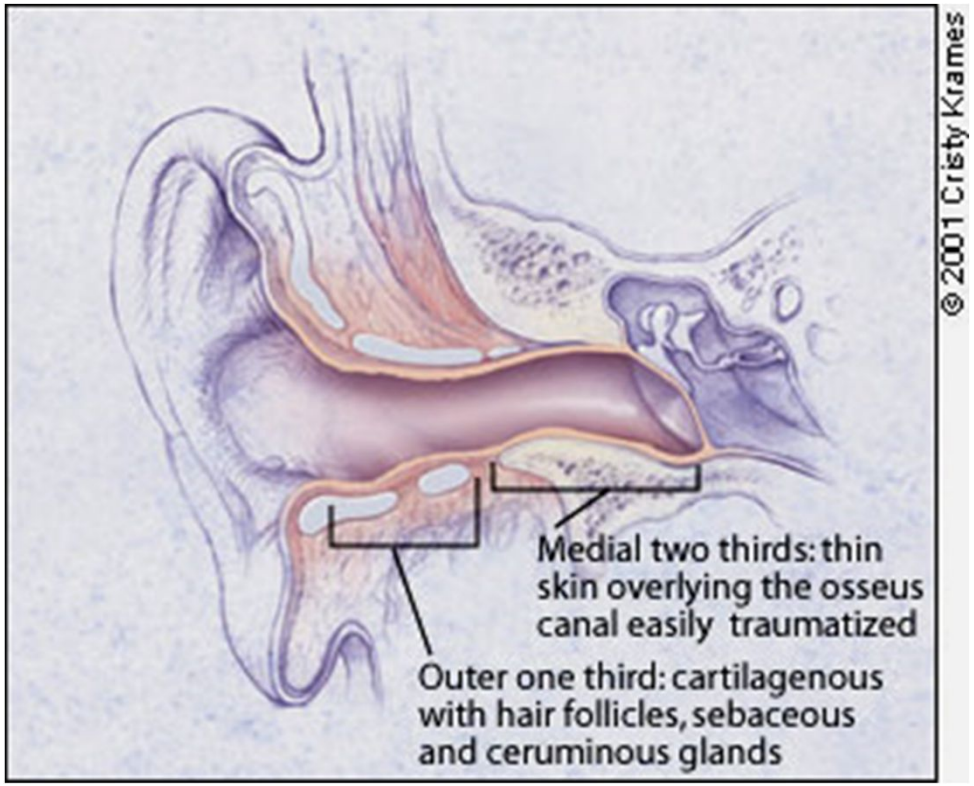
(ii) apocrine:

- axillary & anogenital areas; larger; ducts empty into hair follicles
- same as sweat but + fatty substances & some proteins - odourless until decomposed by skin bacteria •• BO
- function?? - not thermoregulation, like merocrine glands; maybe equivalent of sexual scent glands of other mammals?
- activated by SNS in times of stress

modified sweat glands:

Ceruminous glands - secrete wax (cerumen) in external ear canal

Mammary glands - secrete milk



http://www.aafp.org/afp/2001/0301/p927.html

2.4 *Explain the major functions of the skin*

1. *PROTECTION:* 3 types of barriers
   - chemical: acidic skin secretions (sweat contains dermacidin and other anti-bacterial agents) & melanin
   - physical: barrier to trauma & bacterial invasion; also waterproofing
   - biological: Langerhans cells of epidermis & macrophages in dermis

Not impermeable to: gases, fat-soluble vitamins & steroids, plant oleoresins, organic solvents, salts of heavy metals, penetration enhancers for drug administration

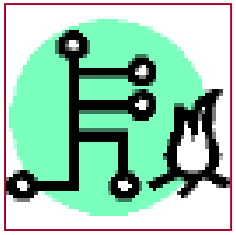
2. *BODY TEMPERATURE:* sweating (0.5-12 L fluid/day)
   vasoconstriction

3. *CUTANEOUS SENSATION: what kinds of information would be obtained?*

4. *METABOLIC:* eg: vitamin D, carcinogens, conversion of topically-applied cortisone to hydrocortisone

5. *BLOOD RESERVOIR:*

6. *EXCRETION: (ammonia, urea, uric acid in sweat)*



Burns: heat, electricity, radiation, chemicals;

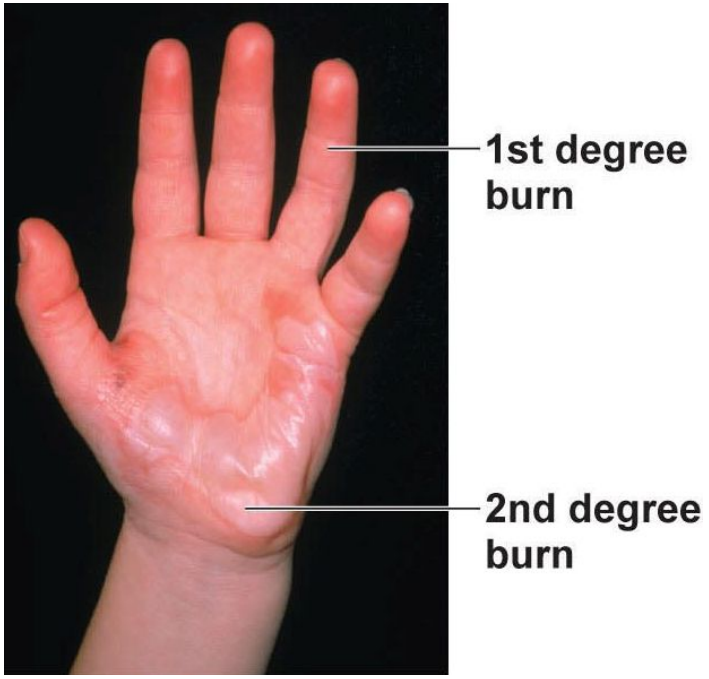
What is the first concern? Second concern?

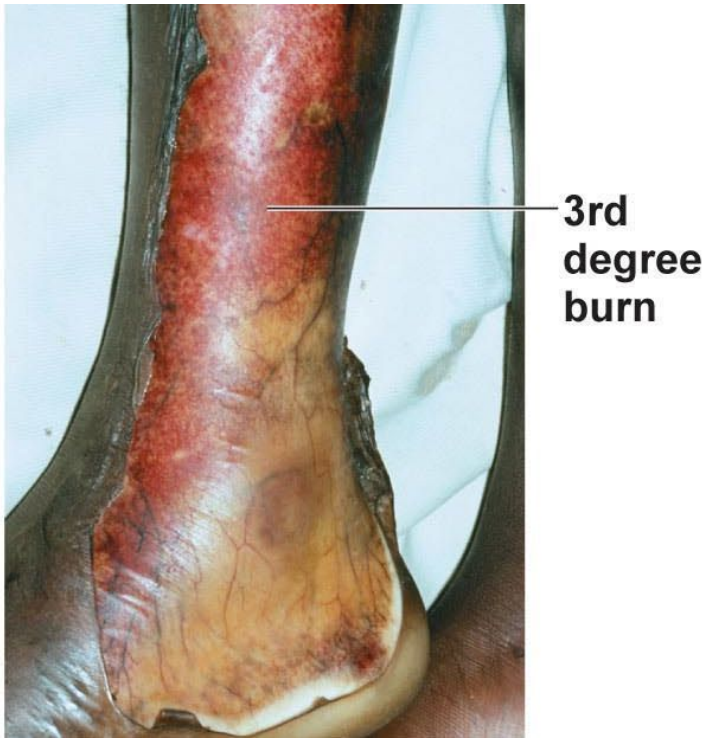
First degree: only epidermis

Second degree: epidermis & upper dermis

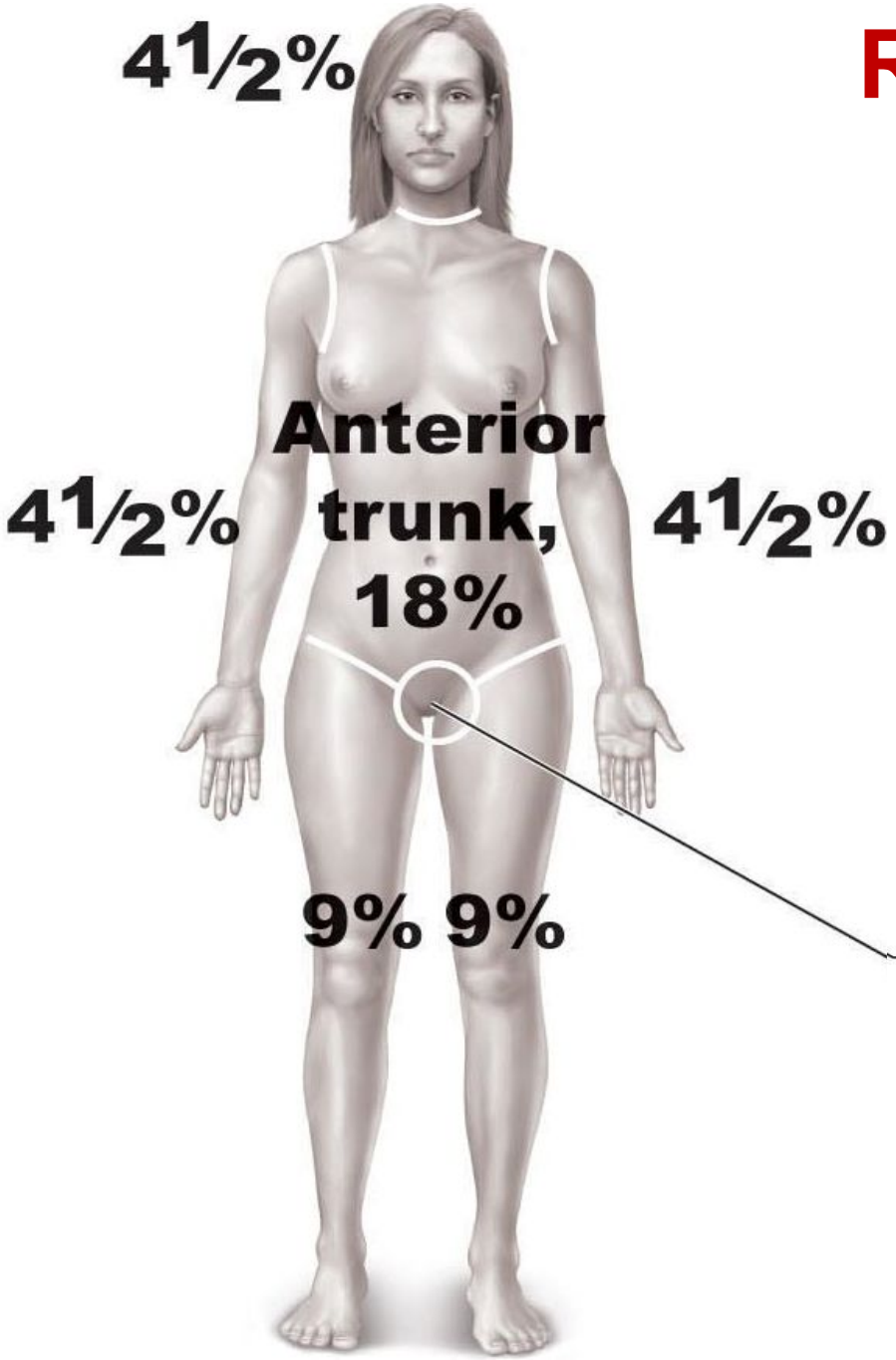
Third degree: entire thickness of skin (epidermis + all of dermis)

Potential for repair? What else can be done? What is the big concern?





Rule of Nines



Totals

Anterior and posterior head and neck, 9%

Anterior and posterior upper limbs, 18%

Anterior and posterior trunk, 36%

(Perineum, 1%)

Anterior and posterior lower limbs, 36%

100%

Click on the picture below to link to this video.