The Integumentary System

Monday, January 7, 2019 4:16 PM

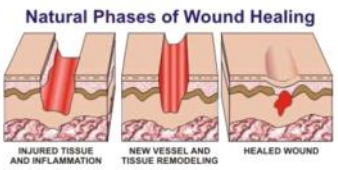
Topic 2: THE INTEGUMENTARY SYSTEM

Chapter 5

What are some things that your skin is able to do?

Barrier
Regulates Body Temp (Thermoregulation)
Rids of wastes (sweat)
Metabolic Functions - activates vitamin D production
Sensory - tough
Immune System - the first line of defense
Accommodates your bodily changes

*"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)*



2.1 Describe the layers of the epidermis

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; vascularized)

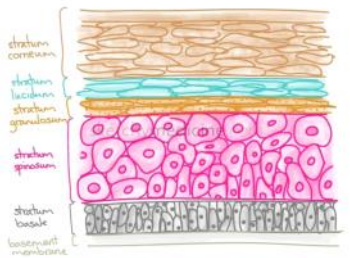
1. Epidermal cells (4 types):

(1) Keratinocytes:

What is the main function of a keratinocyte?

What is the lifespan of a keratinocyte?

What is epidermal growth factor?



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

J. Carnegie, UofO

Epidermis - superficial layer
- Epithelial cells -> not vascularized, too far from blood vessels therefore, the surface is all dead

Dermis - deeper

Epidermis - 4 cell types and 4 Layers (5 for thick skin, but we'll talk bout that later)

Epidermal Cells

Keratinocytes: The biggest one, most epidermal cells are keratinocytes
- Makes keratin.
  - Keratin: fibrous protein that helps the epidermis in its protective properties
- Produced in the deepest layer (stratum basale) and moves up to the upper layers, once it reaches the most superficial layer, it fills up with keratin. Makes it strong and waterproof
- Sturdy, it's great. Butterfly Children
  - They're tied together w. desmosomes for strength and sometimes got tight junctions to stop movement of water between cells.
- Lifespan - produced in the deepest layer and once it hits the most superficial layer, it's 25-45 days (a month). When you're younger, it happens more frequently, hence the dewy skin on young children
  - So, they're made in the stratum basale and continue up and through the different layers, making and filling themselves up with keratin. They'll hit the most superficial layer and be completely dead but stuck together in multiple layers.
- Epidermal Growth Factor - it's this peptide that is produced by various cells throughout the body.
  - EGF causes keratinocytes to undergo continuous mitosis. Important for the epidermis for continuing to grow cuz the thickness.
- Repeated friction -> cell production and keratin formation accelerate -> epidermis thickens -> callus

(2) Melanocytes: produce melanin; deepest layer of epidermis; 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 epithelial cells(Merkel cells): at epidermis/dermis boundary; have a disc-like sensory nerve ending - *touch receptors*

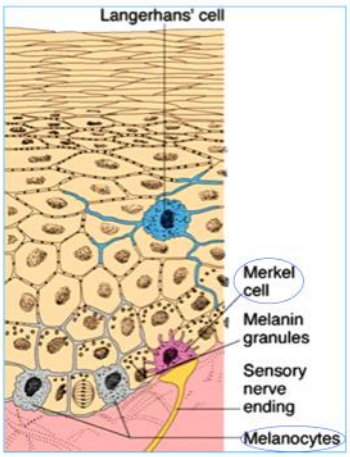


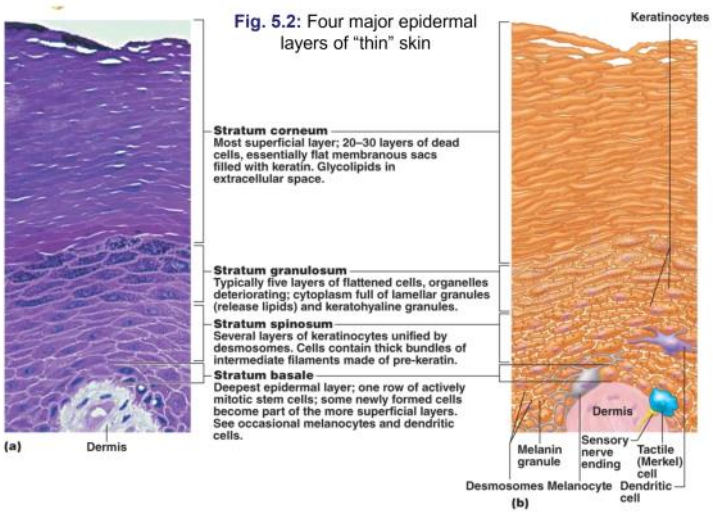
Fig. 5.2 (7th edition)

J. Carnegie, UofO

Melanocytes:
- Produce pigment, melanin
  - For UV radiation, bless that melanin. Melanin begins in the melanocytes and it gets transferred to accumulate in the keratinocytes. It protects those cells.
  - Melanin are there above the nucleus, not below, cuz that's where the sun is
  - Different lengths of time of maintaining the accumulated melanin and other shit like that, it's cool
- In the deepest layer, produces the melanin, which is then accumulated by the keratinocytes
- Melanin is made in membrane-bound granules - melanosomes. The melanosomes are transferred to the adjacent keratinocytes via the cell processes sticking outta them (hence the "sider-shaped" epithelial cell thing). This results in keratinocytes having more melanin than melanocytes

Dendritic Cells:
- Macrophages that get to the epidermis and deals with cuts and tells the immune system when there is a cut so that you're good and not gone die.
- They also got processes that extend round the keratinocytes, it forms a network

Tactile Epithelial Cells:
- Sometimes there at the epidermal-dermal junction
- A spiky hemisphere
- Each tactile epithelial cell is intimately associated w. a disc-like sensory nerve ending. It's s sensory receptor for touch.



Everyone's got thin skin in certain areas and thick skin. Thick sin's only got an extra layer for the extra wear and tear. It's mostly all thin skin, thick skin's like the palm of our hands and soles of our feet.

Thin skin - 4 layers, layers are thinner
Thick Skin - 5 layers, layers are thicker

Refer to the epidermis only

Stratum Basale: Aka stratum germinativum, aka the basal layer
- Deepest of all the layers, attached to the dermis along this wavy border. Close enough to the vascularized dermis for diffusion, so alive.
- Thin, single row of stem cells and are the youngest keratinocytes.
  - Mitotic activity be popping for it, one of each of the daughter cells are sacrificed to the upper layers though where it'll specialize into a mature keratinocyte. The other daughter stays home and continues to reproduce. Wow, Bhauvna
- 10-25% of these cells are melanocytes. They have processes that stick into the stratrum spinosum

Stratum spinosum: Prickly layer
- Keratin synthesis is upregulated for the keratinocytes
- So, when cells are prepped for microscopy, they die and shrink. When observing the stratum spinosum, you'll see keratinocytes with these spiky things connecting them, it's only the desmosomes holding them together.
- Cells in the stratum spinosum have thick bundles of intermediate filaments. These filaments got pre-keratin which resists tension in the cell and are anchored to the desmosomes
- Dendritic cells also be hella abundant here

Stratum granulosum: Granular Layer
- Here's where it's too far for diffusion and so the cells get dying here. Also the glycoproteins cut off any nutrients that happen to make it that far
- 1-5 cell layers
- The keratinocyte undergoes keratinization, where they fill up with keratin, and they change a lot
- Keratinization: The cell flattens, nuclei and organelles begin to disintegrate, and accumulate 2 types of granules
  - Keratohyaline Granules: Help to form keratin in the upper layers
  - Lamellar Granules: Have a water-resistant glycolipid which is secreted into the extracellular space. W. tight junctions and the glycolipid, water loss across the epidermis is slowed down

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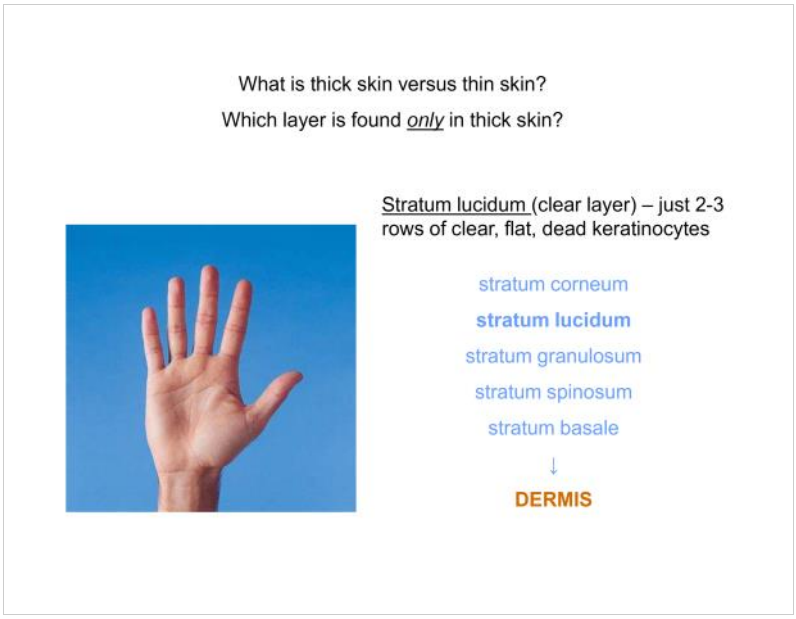
    - There's a lotta proteins w.in the keratinocytes and lipids that're deposited outside, they make the skin tough and water-resistant

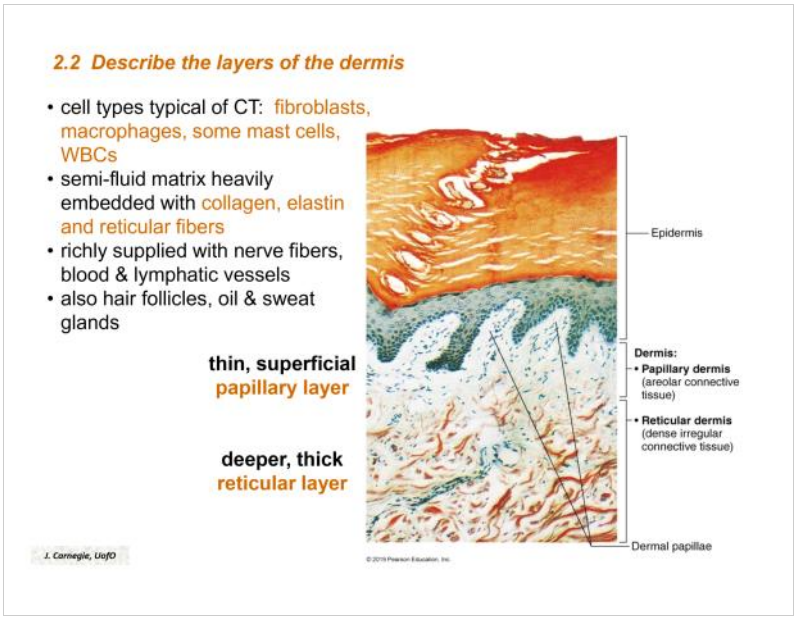


Stratum Lucidum: Clear Layer

- Only in thick skin, visible throughout a light microscope as a thin, translucent band above the stratum granulosum.
- Has got a few rows of flat, dead keratinocytes. They're identical to those at the bottom of the stratum corneum

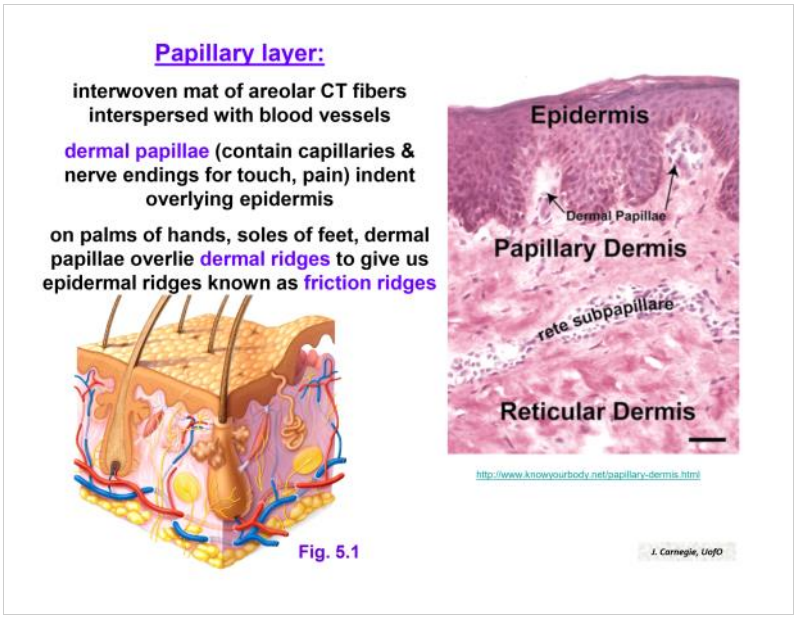
Stratum Corneum (Horny Layer)

- There's an abrupt transition from the nucleated cells of the stratum granulosum to the flattened, anucleate cells of the stratum corneum
- 20-30 cell layers thick (damn). 75% of the epidermis thickness
- Keratin has pre-keratin intermediate filaments embedded in a glue of sorts from the keratohyaline granules
- Keratin and proteins accumulate just inside the PM of these cells, protects from abrasion and penetration.
- Glycolipids keep it mostly waterproof
- You shed 40 lbs of this shit in your life.



Dermis:

- Much thicker, stronger (lots of filaments), vascularized
- Cells typical of any CT proper - fibroblasts, macrophages, and some mast cells and WBCs
- Semifluid matrix has got fibers, it binds the body together. Oh, it's the hide, that's lovely. So that's what leather is, an animal's hide and dermis. Great.
- 2 layers: papillary and reticular, indistinct boundary though



Blood cappilaries in the papillary dermis to meet the needs of the avascular deeper layers of the epidermis. There's lots of different receptors in the dermal papillae which we will study later
In certain areas of the body, they project a lot. They stand up on dermal ridges. And yeah we have these notes already.

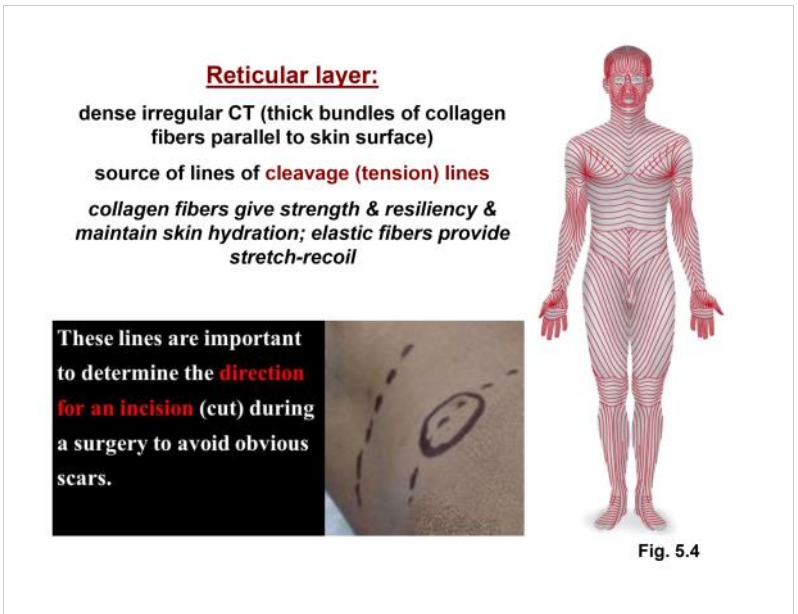
Papillary Dermis: Thin, the superficial one

- Areolar CT, collagen and elastic fibers form a loosely woven mat w. lots of small blood vessels.
  - It's loose for phagocytes and other defensive bitches to patrol the area for bacteria and shit
- There's dermal papillae that go into the superficial epidermis
  - Many of the dermal papillae got capillary loops. Others got free nerve endings (aka pain receptors) and touch receptors (aka **tactile corpuscles, different from tactile epithelial cells in structure**)
  - In thick skin -> the dermal papillae are on top of dermal ridges. The **dermal ridges** cause the epidermis above to form **epidermal ridges.**
    - All of these ridges are called **friction ridges**,
      - It enhances our ability to grip certain kinds of surfaces.
      - Also contribute to our sense of touch by enhancing vibrations detected by the large lamellar corpuscles (receptors) in the dermis.
      - Friction ridge patterns are genetically determined and unique. There are sweat pores open along the crests, it makes our finger tips leave films of sweat (aka fingerprints).

They develop in pre-birth but they become notifiable at birth

The sweat and oil producing glands are right on the tips

Only very serious damage will get rid of them

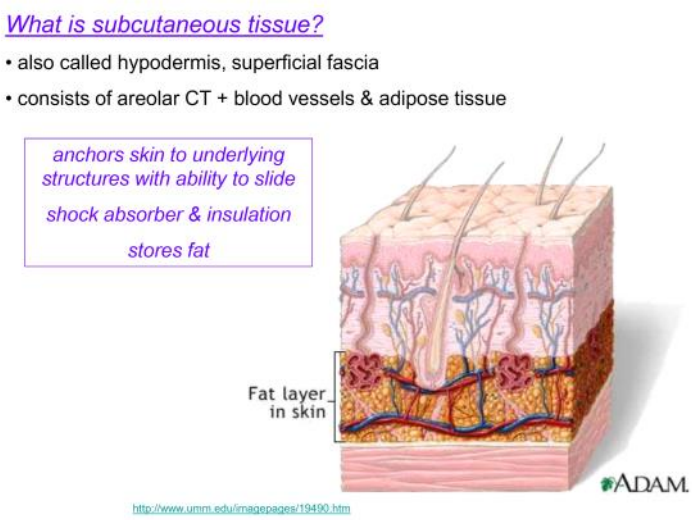


- 80% thickness of the dermis
- Dense irregular CT - vascularized
  - It's called the dermal vascular plexus, the network of blood vessels that supply the dermis. It lies between the dermis and the subcutaneous layer.
  - The extracellular matrix has thick bundles of interlacing collagen fibers
    - Reticular in that it's a network of collagen fibers
- The collagen fibers are in lots of different planes but most are parallel to the kin surface
- Cleavage/Tension Lines: Separations, less dense regions, between the collagen bundles.
  - They tend to run longitudinally in the skin of the lims and in circular patters around the neck and trunk.
  - Important to surgery -> surgeons are to make incisions parallel to cleavage lines so that the skin gapes less and therefore heals more readily and scars less
- The collagen fibers are for skin strength and resiliency that prevents minor shit from penetrating the dermis
- Hair follicles are embedded here as well
- Elastic fibers and reticular fibers (binding sites for various things, ex. WBCs
- The collagen fibers hold water which gives the body a source a fluid. When you're dehydrated, water moves from the collagen fibers to the circulatory system.
- Elastic fibers also have that stetch-recoild property

- Flexure Lines: Dermal folds that occur at or near joints where the dermis is tightly secured to deeper structures (ex. The creases in your palms)
  - Skin can't slide easily to accommodate joint movement so the dermis folds and deep skin creases form

Striae: Extreme stretching of the skin, it tears the dermis and leaves silvery, white scars - the striae/stretch marks

Blister: Short-term acute trauma causes a blister, a fluid-filled pocket that separates the epidermal and dermal layers

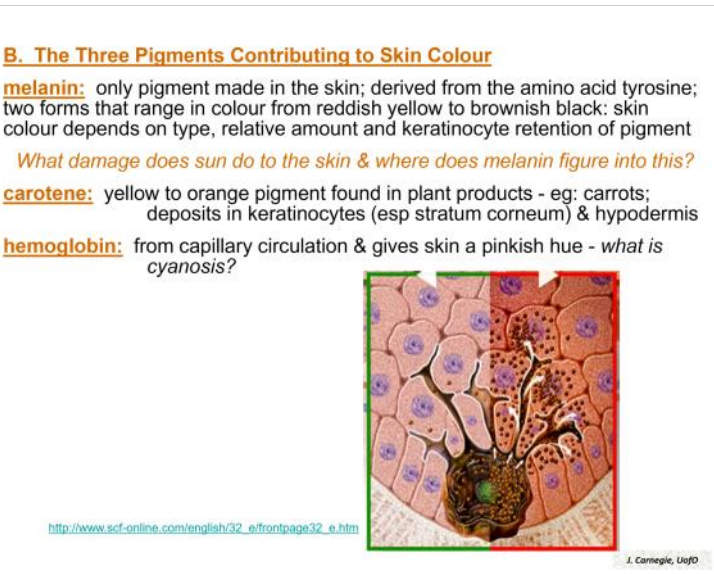


Immediately deep to the skin (dermis)

- Areolar CT - vascularized, WBCs, etc.
  - Adipose is stored there.
    - It's so that when you bump into shit
    - The adipose will absorb that shock rather than letting that affect bones.
    - Insulation.
    - Also, it's a nutrient source (ketones)
    - Also anchors the upper layers. As much as skin needs to have elasticity and movement and durance, it can't be flying off your body with every pull

There's a subcutaneous tissue layer deeper to the dermis.

- It's called the hypodermis or superficial fascia cuz it's superficial to tough CT that is wrapped round skeletal muscles (that's called the fascia).
- Not part of the skin but it takes part in the protective shit that skin does. Mostly adipose and areolar CT



Melanin:

- Made in the skin only, only the one that does that
- It's derived from the tyrosine.
  - Melanin synthesis depends on tyrosinase (an enzyme in melanocytes)
- 2 Forms:
  - One does the red-yellow
  - One does brown-black
- Any colour that you get is a result of how much of each of these are produced and retained by the keratinocytes. It's genetically determined, dependent evolution in relation to exposure to UV radition
  - So, you don't have more melanocytes, they're just more genetically active. And it moves up through the layers from the epidermis and absorbed by keratinocytes which will retain that but eventually lysosomes will eat that shit up and or the keratinocytes will slough off. Therefore, melanin as a pigment exists only in the deeper layers of the epidermis.
  - Freckles and moles (pigmented nevi) are local accumulations of melanin
- When your body recognizes that UV rays are damaging your DNA, had photodamage, (and generally any exposure to sun), it'll activate the repairment processes but also stim the melanocytes
  - Melanin is for the protection of the nuclei of the keratinocytes in the deeper layers of the epidermis, after it reaches the more superficial layers, you ain't gotta worry about it.
  - Sun:
    - Vitamin D
    - Dehydration
    - Activation of melanocytes
    - Ages the skin - Sun spots
      - Elastic fibers clump together and aren't as stretchy. That causes leathery skin, hence farmers and fishermen

Carotene:

- Also deposits in the adipose of the subcutaneous layer. Will give you an orange tinge if you eat enough and are white
- Carotene can be converted to vitamin A, a vitamin that is essential for normal vision and epidermal health

Hemoglobin: From the dermal capillaries, white people be pinkish cuz of it.

- Cyanosis: A blue tinge where blood vessels are close to the skin. Blue cuz there's not a lotta O2 attached to the hemoglobin.
  - Blue-grayish tint - mucous membranes and nail beds
  - Indicative of respiratory and cardiovascular issues
  - People who're darker, you obviously can't see that shit on the surface but inside the oral cavity is where it's at.

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

Hair Functions:

- Doesn't do the same thing since we evolved
- The hair on your head will actually keep you warm (yeah, it do)
- Insects - you'll prolly feel the dislodging of hair first rather than them crawling round
- Eyebrows - shield eyes
- Filter air in your nasal cavity and shit
- The keratin in skin cells is soft keratin but the keratin in the hair is hard keratin.
  - Therefore it's tough and durable
  - Also, individual cells don't flake off
- Your hair is of course dead but there are mitotically active cells just deep to the roots of your head

Hair: The long filaments, aka pili
Hair Follicles: Tubular invaginations of the epidermis from which the hairs grow

Hair root vs shaft -> embedded into the skin or not

Medulla: The central core

- The only part of hair that has soft keratin
- Children and women with very fine hair won't have it

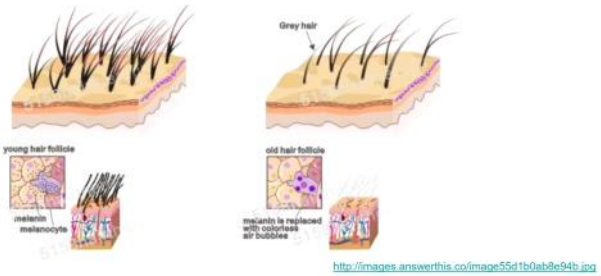
Cuticle: Keratinocytes, the outer protective coating of your air

- When the cuticle wears away, it allows your hair to become more tangled. It's protective, a smooth outer surface for each individual hair
- Most heavily keratinized = strength and keeps the inner layers compact

What are split ends?

Split Ends = the cuticle wearing away, the keratin fibrils of the cortex and medulla frizz

What happens when hair is turning gray or white?

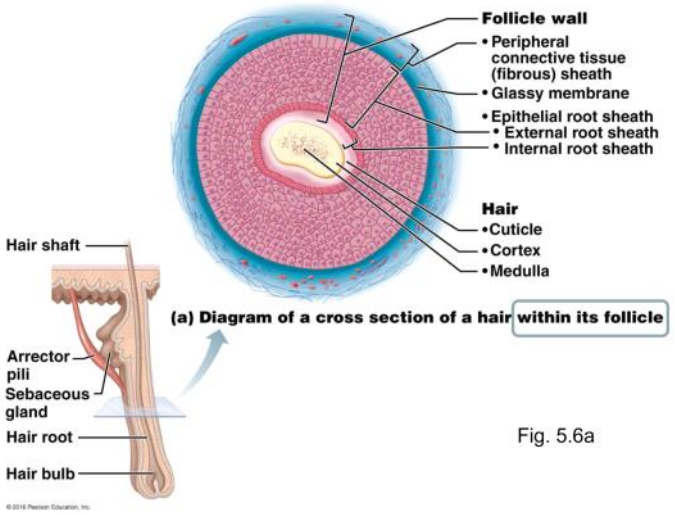


Natural response to aging, more obvious when you have darker hair (true).

- How much pigment is being transferred to the keratinocytes. You won't get as much pigment and so your hair turns lighter, instead there's just air spaces that dilute out the hair colour. So eventually, you won't be producing any pigment
- Producing hair takes a lotta energy and protein so if you're malnourished or hella stressed, there is hair loss and thinning

hair shaft - shape determines if hair is straight or curly

Different hair shaft shapes = types of hair
The presence of a medulla and its diameter will determine the thickness of hair



- Hair follicles fold down into the epidermal surface into the dermis and sometimes into the subcutaneous layer

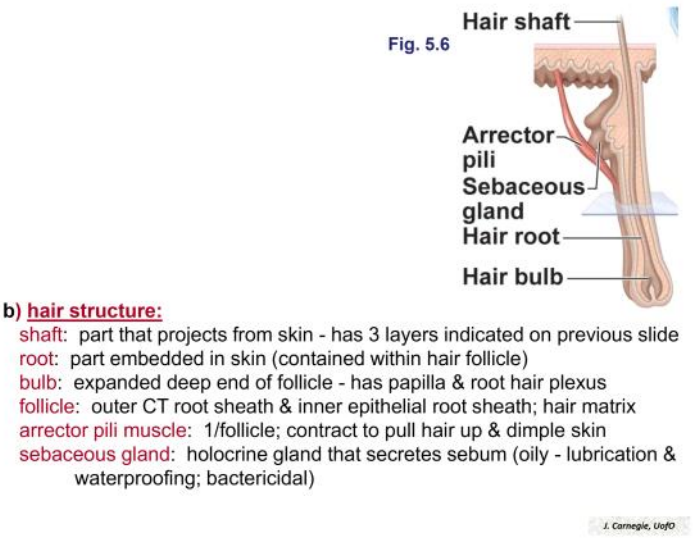
Shaft: Visible above skin
Hair Bulb: The deep end of the follicle, 4 mm below skin
- Pigment-producing cells and dividing cells are at there
- There's a hair follicle receptor/root hair plexus around each bulb (sensory nerves)

Dermal Papilla: The dermal papilla is still there, it's called the papilla of a hair follicle/hair papilla, it protrudes into the bulb
- It has the capillaries for nutrients for growing hair and signals for growing
- If it gets fucked with, hair won't grow no more

Arrector Pili: Each hair follicle has a very small muscle but it allows hair to stand up (vestigial structure)
- Heat conservation
- Makes you look bigger, intimidation
- Strong emotion (ELT)
- For humans though, the contractions of the arrector pili forces out sebum out of the hair follicles where it acts as a skin lube on the epidermal surface.

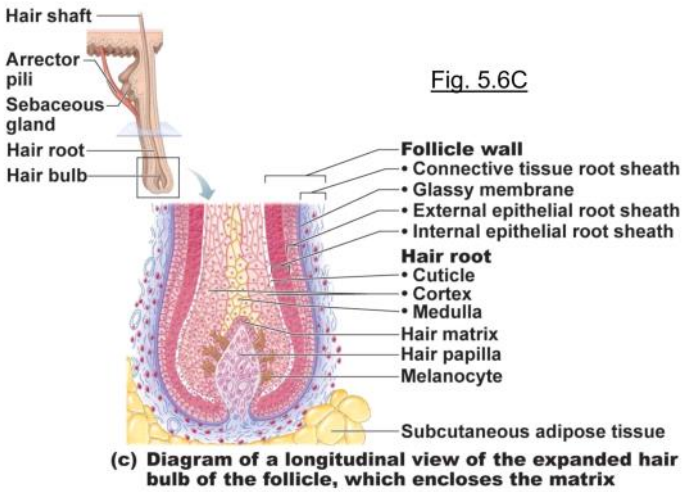
Sebaceous Gland: Oil-producing gland
- Slows down the loss of water
- Coats the hair shaft as it grows to discourage tangling

Don't worry bout the different different parts of the follicle wall
- The outside parts of the dermis (blue - peripheral CT, fibrous, sheath)
- Glassy membrane - the basement membrane that separates the dermis from epidermis
- Inside, pink, parts of the epidermis
  - External root sheath = direct continuation of the epidermis
  - Internal root sheath = continuation of matrix cells



Hair matrix - mitotically active cells be there
- Lie immediately adjacent to the hair papilla
- As they divide, the hair matrix cells are replenished by stem cells that migrate down to the bulb from the hair bulge, a region closer to the skin surface

Sebaceous gland are holocrine glands (the erupting one, refer to last semester)
- The oil it produces also has a bactericidal property that kills bacteria. That's cool
- Found everywhere 'cept in the thick skin of the palms and soles
- Small on the body trunk and limbs but big on the face, nexk, and upper chest
- So, the sebaceous glands are branched alveolar glands. The central cells of the alveoli accumulate oily lipids until they bust - holocrine, again
- Most develop as outgrowths of hair follicles and secrete sebum into either hair follicles or into a pore on the skin surface
- Softens and lubes hair and skin, prevents hair from being brittle and slows water loss from the skin
- Increase in activity after puberty, influenced by androgens



That little indent at the bottom is the dermal papillae, to provide blood vessels and shit
Yellow - medulla
Pink - Cortex
White - Cuticle

Dark pink and onwards = Follicle wall

Vellus Hair: The body hair that women and children grow
Terminal Hair: Scalp hair, eyebrow hair, it has the central medulla. Stronger and sturdy
- Puberty = terminal hair appears in places
- It grows in response to androgens (male-majority sex hormones, testosterone be important)

Hormones:
- Testosterone affects shit (gets turned into another edition of testosterone), it stims hair growth

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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 mm/week
- growth cycles: active growth phase → regressive/resting phase; each hair follicle has only a certain number of growth cycles before it is done

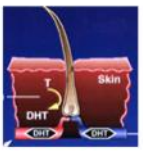
Which hair has a longer active phase - eyebrow or head hair?

What is alopecia?

- Baldness that is often patchy
- Can be autoimmune in origin

What is male pattern baldness?

- genetically-determined, gender-influenced
- altered response of hair follicle to androgen that shortens growth cycles



Hormones:
- Testosterone affects shit (gets turned into another edition of testosterone), it stims hair growth

Nutrition:
- Protein is important. The hard keratin is derived from tyrosine again

Hirsutism: When you got hair in places where you shouldn't (generally women)
- Polycystic ovarian disease indicator
- Adrenal issues, like tumors or some shit (more testosterone being produced than normal)

Each different follicle are in different growth cycles:
- A hair follicle will rest after it grows. Eventually the matrix becomes inactive and it stop growing for awhile but then when it reactivates, it sheds the old hair and starts again.
- Hair on your head is in a growing phase for years which is why it can grow so long
    - When your hair follicle goes dormant, you will lose the hair entirely before the follicle reactivates
  - Eyebrow hair has a growth cycle for a few weeks, which is why it doesn't grow so long
  - When you get older, your follicles get tired so sometimes, they won't ever reactivate after going dormant. That's why hair gets thinner with age and why hair gets shorter, the growth cycle is so short

Balding - natural with aging. More follicles go dormant and just don't start up again. Terminal hair gets replaced by vellus hair, which is why old people have this soft, wispy hair (Amma)

Alopecia: Patchy hair, follicles that are dormant for some reason where it shouldn't be

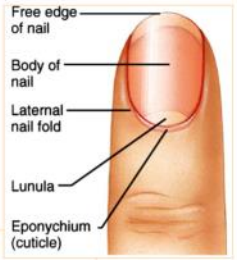
Male Pattern Baldness: Different than the natural balding process
- Comes from maternal side
- Altered response to testosterone, responds strongly. But then it goes with shorter and shorter growing periods.
  - Goes from growth phase for years but then eventually the growth phase is so short that the hair shaft never reaches the surface

2. Nails:

scale-like modification of epidermis - protective, useful tool

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

What is the lunula?



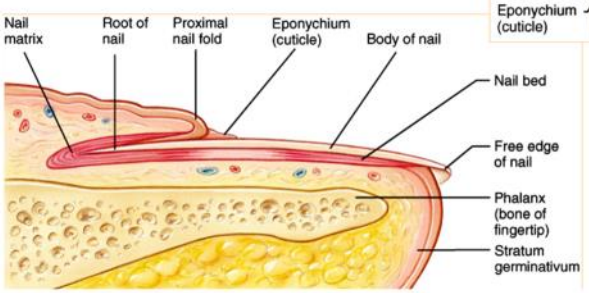


Fig. 5.7

Nail: Clear, protective covering on the dorsal surface of the distal part of the finer or toe
- Hard keratin

Nail root -> nail plate/body -> free edge

There's a nail matrix: Actively dividing cells are there

Nail Bed: The surface that the nail is being pushed along
- Only the deeper layers of the epidermis cuz the nail corresponds to the superficial keratinized layers

Nail folds are there to anchor the nail in place
- The cuticle/eponychium

For protection of course

Nails are usually pinkish cuz there's a big ass bed of capillaries right underneath the underlying dermis

Lunula: Represents where the nail is in the matrix. Is white cuz the underlying blood vessels can't colour it cuz it's so thick, not in direct contact with those capillaries

Hyponychium: The last little place where the epithelium thickens to hang onto the nail before it extends beyond the tip of your finger

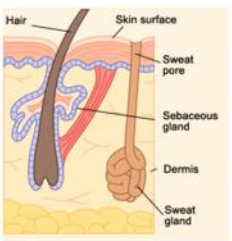
Spoon Nail - concave superiorly

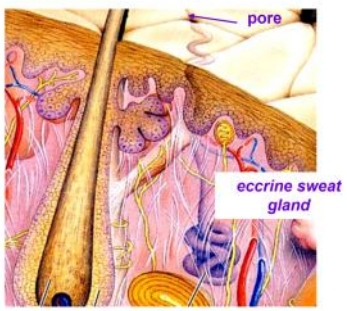
3. *Sweat Glands (sudoriferous glands):*

distributed over skin surface except nipples & parts of external genitalia- up to 3 million/person

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

What is sweat??





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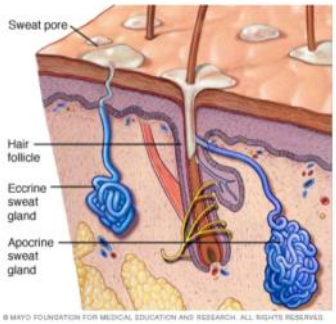
Sudoriferous Glands = Sweat Glands
- You produce sweat to cool down cuz when that sweat evaporates away, it takes heat with it
  - Heat sweat - starts in the forehead and spreads down
  - Cold sweat (emotional) - starts in the palms, soles and armpits and then spreads elsewhere
- 2 Types: Eccrine and Apocrine

Eccrine glands: Aka, merocrine sweat glands
- A single, coiled tubular gland
- The secretory part is coiled up in the dermis and the duct extends into the open w. a thing called a pore (funnel-shaped)
  - Sweat pores are different from pores you see on your face, those "pores" are where hair follicles be coming from

Sweat: Hypotonic filtrate of the blood that passes through the secretory cells of the sweat glands and is released via exocytosis
- Water
- Ionized salt (mostly NaCl)
- Some metabolic wastes (urea, uric acid, ammonia)
- Antibacterial chemical - dermcidin, a peptide
- pH = 4-6

(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



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Apocrine (Also a sweat gland but doesn't do thermoregulation)

- Are actually merocrine glands as well cuz they release their products via exocytosis like the eccrine glands
- In the axillary and anal genital areas, they're bigger and are embedded deeper in the dermis and subcutaneous layers
- It can be milky or yellowish in colour. Jesus fucking christ, that's weird
- Empty into the hair follicles rather than skin surface
- Odourless but there are skin bacteria that'll break it down to produce BO
  - So apocrine glands not eccrine lends to that smell
- Potentially activates in puberty and things like that which lends to its theorized function
  - Sexual foreplay increase their activity
  - Enlarge and recede w. the menstrual cycle
  - Might be pheromones

Table 5.1 Summary of Cutaneous Glands

	ECCRINE SWEAT GLANDS	APOCRINE SWEAT GLANDS	SEBACEOUS GLANDS
			
Functions	• Temperature control • Some antibacterial properties	May act as sexual scent glands	• Lubricate skin and hair • Help prevent water loss • Antibacterial properties
Type of Secretion	Hypotonic filtrate of blood plasma	Filtrate of blood plasma with added proteins and fatty substances	Sebum (an oily secretion)
Method of Secretion	Merocrine (exocytosis)	Merocrine (exocytosis)	Holocrine
Secretion Exits Duct At	Skin surface	Usually upper part of hair follicle; rarely, skin surface	Usually upper part of hair follicle; sometimes, skin surface
Body Location	Everywhere, but especially palms, soles, forehead	Mostly axillary and anogenital regions	Everywhere except palms and soles

Similar to sweat glands in structure and that's all

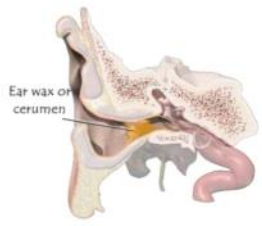
Ceruminous glands: Wax that discourage insects from climbing up in there (Azhauna)

- Mixes with sebum produced by nearby sebaceous glands to form the sticky, bitter cerumen

Modified Sweat Glands:

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

Mammary glands - secrete milk



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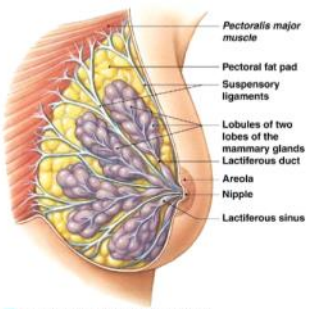

The mammary glands of the left breast

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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: dendritic 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: dermis can hold about 5% of total blood volume
6. EXCRETION: *(ammonia, urea, uric acid in sweat)*

1. Protection:
   a. Chemical Barriers: skin secretions and melanin
      i. The skin secretions are called the acid mantle collectively, it has a low pH and it fucks with the reproduction of bacteria
      ii. There's also the dermcidin and bactericidal shit in sebum
      iii. There's also defensins - they literally punch holes in bacteria
      iv. There's cathelicidins - protective peptides for bacteria
   b. Physical Barriers: It's great, does a bunch. There's small, continual water loss from the epidermis though
      i. Anything lipid soluble can pass through the skin actually (wow)
   c. Biological Barriers:
      i. Dendritic Cells - catch the invaders and then goes off to show the immune system this in the nearest lymph node. It stims. an immune response.
      ii. Dermal macrophages
2. Body temp.
   a. Sweating
      i. There's insensible perspiration that happens below 31 degrees, it's only bout 0.5 L/day. Above that, is sensible perspiration and that shit goes up to 12 L/day.
   b. Moving of blood either closer or further from the skin to fit the temperatures
3. Sensation
   a. Temperature, texture, shape, pain, etc.
   b. They're called cutaneous sensory receptors and they're exteroceptors cuz they pick up info from the outside
4. Metabolic
   a. Sometimes there's conversion of chemicals to other chemicals that can be carcinogenic
5. Blood Reservoir
   a. So if you lose blood you get pale

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?

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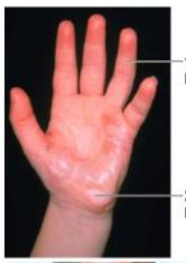


Burns are the most severe. The deeper it goes, the more dangerous it becomes.

3rd degree - you might not even feel the pain cuz you fucked up the pain receptors, swelling won't even happen initially either cuz it's all so fucked up

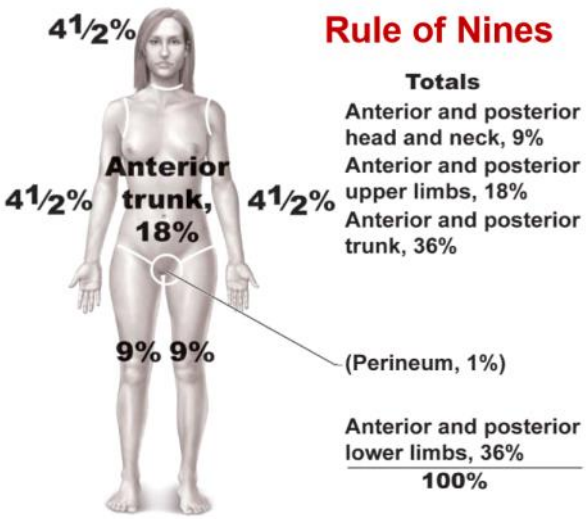
First Concern: Fluid loss

Second Concern: Infection

Repair is obviously harder for the higher degree of burn it is. Skin graphs can be done for people who're extensively burned but then again, skin graphs can be rejected

First and second degree burns are called partial thickness burns. Similar symptoms in that there is swelling and redness and pain but second degree burns differ in that there are blisters.

- First degree burns can heal well on their own, readily and without scarring in a few days
- Second degree burns will take a 3-4 weeks with minor scarring as well
- Third degree burns can technically heal on their own in the same fashion but the issue is that fluid loss and infection is such an issue that it's impossible to have it happen. Therefore, skin grafts are basically necessary
  - Third degree burns are referred to as full thickness burns. Mrs. Battersby's nephew, damn that nigga was crazy to think that shit would work out, poor guy.



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.

Maybe watch that