Topic 2: Chapter 5: The Integumentary system

5.1

- Skin is about 7% of the total body weight
- Its made up of two distinct layers; epidermis and dermis

EPIDERMIS	DERMIS
-Made up of epithelial cells -Outermost protective shield of the body -not vascularized: -nutrients reach it by diffusing through the tissue fluid from blood vessels in the dermis -avascular epithelium	-Bulk of the skin -Tough -Made up of mostly dense connective tissue -vascularized Better nourished than the epidermis due to the it being vascular

- Hypodermis: subcutaneous tissue under the dermis layer of the skin, NOT part of the skin
- Hypodermis is also known as Superficial Fascia
    - Because its superficial to the tough connective tissue wrapping "fascia" of the skeletal muscles
- Hypodermis
    - consists of mainly adipose tissue
        - Stores fat
    - Anchors skin to underlying structure (mainly muscle)
        - Although loose enough that the skin can slide freely over what's under it
        - Ability to slide lets skin protect us by letting blows just glance off our body
    - It's a shock absorber and an insulator that reduces heat loss
        - Due to its fatty composition

5.2

- Epidermis is made up of four different cell types and four/five distinct layers
- Cells in Epidermis
    - Keratinocytes
    - Melanocytes
    - Dendritic Cells
    - Tactile Cells

- Keratinocytes:
    - Main role to produce keratin
        - Keratin is the fibrous protein that is responsible for the protective properties of the epidermis
        - Forms most of the epidermal cells
    - Keratinocytes are connected by desmosomes
    - They arise from the deepest part of the epidermis
    - The cell layer of the epidermis they come from is known as the Stratum Basale
    - Go through continuous mitosis
    - Due to the epidermal growth factor, which is a peptide produced by many cells around the body
    - When the keratinocytes are pushed up due to the formation of new cells beneath them, they make the keratin that dominates their cell content
    - When keratinocytes reach the skin surface, they are dead, scale-like structures
    - These dead structures are little more than keratin-filled plasma membranes

  - Keratin formation is accelerated in body areas that are subjected to friction (like the hands or feet)
  - Constant friction causes the thickening of the epidermis which is known as Callus
  - Millions of the keratinocytes rub off every day, resulting in a new epidermis every 25-45 days

- Melanocytes
  - Spider shaper epithelial cites
  - Found in the deepest layers of the epidermis
  - Synthesize the pigment melanin
  - Melanosomes: membrane bound granules in which melanin accumulates as its being formed
  - Motor proteins then move the melanosomes along actin filaments to take them to the end of the melanocytes process "the spider arms"
  - The melanosomes are then transferred to nearby keratinocytes (4-10)
  - Melanin granules (melanosomes) then accumulate on the superficial side of the keratinocyte nucleus forming a pigment that protects the nucleus from UV radiation in sunlight's damaging effects

- Dendritic Cells
  - Star shaped
  - Arise from bone marrow and move to the epidermis
  - Aka Langerhans Cells
  - Ingest foreign substances
  - Key activators in immune system
  - Slender process extends around the keratinocytes, evading to the formation of a more/less continuous network

- Tactile Cells

  - Found in the epidermal-dermal junction
  - Shaped like a spiky hemisphere
  - Each cell is intimately connected to a disc like sensory nerve ending, this combo is knowns as a tactile/Merkel disc
  - Tactile/Merkel Discs function as a sensory receptor for touch

- The epidermal is made up of either five/four layer depending on whether the skin is thick or thin
- Thick skin covers areas of abrasion like the palms, fingertips and the soles of the feet
- Thick skin is made up of five layers
- Thin skin covers the rest of the body
- Thin skin is made up of four layers, it lacks the stratum lucidum, the other strata are also thinner
- Strata=Layers
- From Deepest to most Superficial
  - Stratum Basale
  - Stratum Spinosum
  - Stratum Granulosum
  - Stratum Lucidum (only in Thick skin)
  - Stratum Corneum

Strata (Layer)	
Stratum Basale (Basal Layer) Or Stratum Germinativum (Germinating Layer)	-deepest epidermal layer -attached to the dermis under it along wavy borderline that is like corrugated cardboard -made up of mainly a single row of constantly renewing stem cells that are the youngest keratinocytes -numerous mitotic cells in the layer lead to the rapid division and are the reason for its alternate name 'stratum germinativum' -whenever a basal cell divides, a daughter cell is pushed in to the cell layer to form a mature keratinocyte

	-the other daughter cell stays to continue producing more keratinocytes in the basal layer -10-25% of the cells in the basal layer are melanocytes -the branching processes of melanocytes extend to the layer above the basal layer
Stratum Spinosum (prickly layer)	-several layers thick -cells have a web like system of intermediate filaments -these webs are mostly tension-resisting bundles of pre-keratin filaments that span their cytosol to attach to desmosomes -keratinocytes in this layer look like spiker iron balls Keratinocytes appear to have spines which cause them to be named prickle cells -the spines don't exist in living cells, they form due to tissue preparation when the cell shrinks but its many desmosomes hold it tight -there are also melanin granules and dendritic cells, which are most abundant in the epidermal layer
Stratum Granulosum (Granular Layer)	-thin -made up of 1 to 5 layers -keratinocytes change drastically in it -keratinization process begins here -Keratinization is the process in the which the cells fill with keratin -the cells flatten, nuclei and organelles begin to disintegrate and thy accumulate 2 types of granules -keratohyalin Granules: help form keratin in the upper layers -lamellar granules: contain a water-resistant glycolipid that's spewed into the extracellular space -the glycolipid and the tight junctions play a major role in slowing water loss across the epidermis -the plasma membrane of the cells thickens as the cytosol proteins bind to the inner membrane face and the lipids

	realised but the lamella granule coat their external surfaces -the previous events create an epidermal water barrier and makes cells more resistant to destruction -can be said that the keratinocytes toughen up to make the outer layers the strongest skin region -epidermis relies on capillaries in the underlying connective tissue (the dermis) for its nutrients -Above this layer the epidermal cells are to far from the dermal capillaries and the glycolipids coating the external surfaces cut them off from nutrients and they die
Stratum Lucidum (Clear Layer) *only in thick skin	-thin translucent band above the granulosum -some consider it a subdivision of the superficial stratum Corneum -made of 2/3 rows of clear, flat, dead keratinocytes with distinct boundaries -the gummy substance of the keratohyalin granules clings to the keratin filaments in the cell -this causes the keratin cells to form large, parallel arrays of intermediate filaments known as tone filaments
Stratum Corneum (Horny Layer)	-sudden change from the nucleated cells of the granulosum and the flattened anucleate cells of the Corneum -outermost epidermal layer 20 to 30 cell layers thick -makes up 3/4ths of the epidermal thickness -keratin and the thick plasma membranes in this layer protect the skin against abrasion and penetration -the glycolipids between its cells make the layers almost waterproof -provides an overcoat of sorts for the body -Its protects the deeper cells from hostile external environments “air”, water loss, and rendering the body

	somewhat insensitive to biological, chemical and physical assaults -what differentiates the cells in the basal layer from those in the Corneum is a specialized form of apoptosis where the nucleus and organelles break down a=and the plasma membrane thickens -Terminal cells don't fragment but slough off the skin -the shingle-like cells of the Corneum are referred to as cornfields or horny cells (horn=cornu) -these cells are known as dandruff, shed from the scalp and dander, the dry flakes of the skin - on average 50,000 dead cells are shed every minute and 18kg skin flakes in a life time

- The desmosomes connecting the keratinocytes are important as the skin goes through lots of physical trauma and abrasion and theses connecting junctions help hold the cells together during all that stress
- Stratum Basale is also known as the Stratum Germinativum due to the almost continuous mitosis to replace the cells lost due to abrasion

5.3

- Dermis is composed of strong, flexible connective tissue
- Dermis has cells of the connective tissue proper's
  - i.e. macrophages, macroblasts, occasional mast cells, white blood cells
- it's a semifluid matric, embedded with fibres
- dermis binds the body like body stocking
- dermis is rich in nerve fibres, blood vessels and lymphatic vessels
- major portions of the hair follicles, as well as oil and sweat glands derive from the epidermal tissue but reside in the dermal tissue
- its made up of two layers, which lie next to one another along a distinct boundary
  - the papillary
  - the reticular
- Papillary layer:

  - Thin, superficial
  - Made up of areolar connective tissue
  - In it interlacing collagen fibers and elastic fibres form a loosely woven mat that is heavily invested with small blood vessels
  - The looseness of connective tissue allows phagocytes and other defensive cells to monitor the area for bacteria that may have penetrated the skin
  - Dermal Papillae: peg like projections on the surface, indent the overlaying epidermis
  - Many of the dermal papillae contain capillary loops, some have free nerve ending i.e. pain receptors, and some house touch receptors aka Tactile or Meissner's Corpuscles
  - In thick skin the papillae lie on larger mounds known as dermal ridges which result in the epidermis above it to form epidermal ridges
  - Theses ridges that can bee found in the hands and feet are known as friction ridges
  - Friction ridges are believed to enhance the gripping ability of the fingers and feet
  - Recent studies show they amplify our sense of touch by amplifying the vibration detected but the large receptors in the dermis
  - Friction ridges are genetically determined and unique to every individual
  - There are sweat pores open along the crest of the friction ridges
  - The sweat pores combined with the friction ridges leave identifying films of seat called fingerprints on almost everything that they tough
- Reticular Layer:
  - Deeper
  - 80% of the thickness of the dermis
  - Dense irregular connective tissue
  - Network of blood vessels that nourished it is known as the cutaneous plexus lies between this layer and the hypodermis
  - Its extracellular matrix has pockets of adipose tissue and think bundles of interlacing collagen fibres
  - Collagen fibres run in different directions but most are parallel to the skin

- Cleavage Lines are less dense regions between collagen fibres, they're externally invisible, they run in longitudinal lines in the skin of the head and the limbs and in circles around the head and the trunk
- Cleavage lines are important to surgeons because they make incisions parallel to these lines as in those areas the skin gapes less and heals more readily
- The collagen fibres give sting its strength and resilience that prevent injury to the dermis
- Collagen also binds water keeping the skin hydrated
- The elastic fibres give skin its elasticity
- Flexure lines are dermal folds that occur near joints where the dermis is tightly secured to deeper structures (like the creases in your palm).
- Because the skin can't fold to accommodate the joints in regions of flexure lines, the dermis folds and creases are forms
- Flexure lines can be fount on the wrists, soles, toes and fingers
- Striate commonly known as stretch marks are tears in the dermis caused by extreme stretching of the dermis that leave silvery white scars (like the ones that tent to appear on the belly of a pregnant women)
- Blister a fluid filled pocket that separate the dermal and the epidermal layer may appear due to acute short term trauma (like a burn or repeated friction)
- When you get a cut with no bleeding its because you have only cut the avascular epidermis

5.4

- Skin colour is determined by melanin, carotene and hemoglobin
- Of the three that contribute to skin colour only melanin is made by the skin
- Melanin
  - Polymer
  - 2 forms that range in colour from reddish yellow to brownish black
  - Synthesized by an enzyme in melanocytes known as tyrosinase

  - It goes from the melanocytes to the basal keratinocytes
  - Lysosomes break down the melanosomes, hence the melanin pigment is found in the deeper layers of the epidermis
  - All humans have the same number of melanocytes
  - Difference in skin colour is caused by the kind and amount of melanin is made and retained
  - People with darker skin to brown skin produce more darker melanocytes
  - Fair skinned people make lighter and less melanocytes and their keratinocytes retain longer
  - Freckles and pigmented nevi(moles) are local accumulations of melanin
  - Exposure to sunlight's results in keratinocytes secreting more chemicals that's stimulate melanocytes
  - Long exposure causes melanin build as it helps protect DNA of viable skin cells from the UV radiation
  - Melanin protects from UV radiation by absorbing the rays and dissipating the energy as heat
  - Initial sign of melanin syntheses speed up, is the faster repair rate of photodamaged DNA
  - This defensive response can cause skin to darken
  - UV radiation can alter the DNA of skin cells and stop the body from making folic acid
- Carotene
  - Yellow or orange pigment found in certain plants
  - It accumulates in the sternum corneum and in the fatty tissue of the hypodermis
  - Colour is most obvious in the palms and soles because that's where the stratum corneum is thickest and most tense when large amounts of carotene rich products have been consumes
  - Body can convert in to Vitamin A which necessary for normal visions and epidermal health
- Hemoglobin
  - Pinkish hue of people with fair skin is caused by the crimson colour of the oxygenated pigment

- Hemoglobin is found in red blood cells circulating through the dermal capillaries
- Due to small amounts of melanin, epidermis is nearly transparent and allows the hemoglobin colour to show
- Cyanosis when the hemoglobin is poorly oxygenating and someone with fair skin appears blue, this occurs sometimes after heart failure and severe respiratory disorders
- Dark skin won't appear blue as the melanin covers it up
- Jaundice is a yellow colour to the skin due to the deposit of yellow bile pigments in the body tissues due to liver disorder

5.5

- Function of the hair
  - Sense insects on the skin
  - Guard head form physical trauma, heat loss, sun
  - Shield eyes
  - Filter particles from inhaled hair
- Hair and hair follicles are made up of hard keratin, as its more doable and does not flake
- Hair shaft
  - Medulla: large cells that are separates by air spaces and are absent in fine hairs
  - Cortex several layers of flattened keratinocytes, this is where the pigment resided
  - Cuticle: single layer of over lapping cells
- The hair shaft determines whether the heal is straight or curly
- Hair structure
  - Shaft: part of hair that projects from skin, has three layers (cuticle, cortex, medulla)
  - Root: part embedded in the skin that contains the hair follicle
  - Bulb: expended deep end of the follicle- has papilla and root hair plexus
  - Follicle: outer connective tissue root sheath and inner epithelial root sheath; hair matric

    - Arrector Pili Muscle: one per follicle, and contracts to pull hair up and dimple skin
    - Sebaceous Gland: holocrine gland that secretes sebum (oily), which provides lubrication, waterproofing; bactericidal which stops infection when the follicle is open
- Hair is made up of hard keratin, where skin is made up of soft keratin
- Medulla lacks in fine hair which is the hair found on the bodies of females and children
- Split ends are caused by damage to the cuticle area of the hair shaft
- Hair turns grey because less pigment is being made, when it goes completely white no pigment is being made at all
- Vellus hair is the hair found on the bodies of females and children
- Terminal hair is the hair found in males, in the groin area
- Hair grown this affected by hormones and nutrition
- Testosterone influences hair growth, hence men grow beards
- The average hair growth cycle is 2.5 mm a week
- Growth cycles
    - Active growth phase
    - Regressive/Resting phase
- Note that each follicle has a certain number of cycles before its done
- Hirsutism is excessive hairiness in women, a sign of masculinization, may result from an adrenal gland or ovarian tumor that secretes abnormally large amounts of androgens, condition in women with excessive hair growth do to increased amounts of testosterone
- Head hair has a longer active phase compares to eyebrow hair
- Alopecia is the physiological term for baldness, when hair is shed faster than its replaces, coarse terminal hair is replaced by vellus hair
- Male Pattern Baldness is the most common type of true baldness and is a sex-influenced genetically determined condition where the follicle growth cycles are so short that many hairs don’t even emerge from the follicle before shedding and those that do are fine vellus hair

5.6

- Nails are scale like modifications of the epidermis, protective, useful tool
- Forms a clear protective covering on the dorsal surface of the distal surface of fingers and toes
- Nails contain hard Keratin
- Each nail has a free edge, a nail plate (visible attached portion), and a proximal root (embedded into the skin)
- The nail is made up of four specialized epithelia the proximal nail fold, the nail matric, the nail bed and the hyponychium
- Deeper layers of epidermis extend beneath the nail bed
- Nail matric is the thickened proximal portion of the nail bed and is responsible for nail growth
- The free edge and the body are lateral, while the nail fold is proximal
- Lunula is the region that lies above the thick nail matrix, which is white because the thick nail matrix blocks the rosy colour of the dermal blood supply from showing through
- Changes in the nail colour help diagnose certain conditions
    - Yellow-Tinged: fungal infection or serious reparatory disease or thyroid gland disorder
    - Thickened: Fungal infection
    - Spoon Nail: Iron deficiency
    - Beau's Lines: (horizontal): malnutrition, lines formed due to variable stoppage of nail growth

5.7

- Sebaceous glands are found all over the body except in nipples and parts of the external genitalia
- There are two types of sweat glands:
    - Merocrine (eccrine)
        - More common
        - Found esp. in palms, soles, forehead
        - Simple coiled tubular glands with pores at surface
        - Secretes sweat, which is defined as the hypnotic filtrate of blood which 99% water, with some salts, vitamin C, antibodies and microbe-killing peptides called dermcidin, traces of metabolic waste (urea, uric acid, ammonia), exact composition

depends on heredity and diet, small amounts of ingested drugs may be secreted this way too
        - Function:
    - Apocrine
        - In axillary and anogenital areas
        - Larger, ducts empty into hair follicles
        - Same as sweat but also has fatty substance and some proteins, odourless until decomposed by bacteria
        - Function not truly known, maybe equivalent to sexual scent glands of mammals
        - Activated by SNS in times od stress
- Modified Sweat Glands
    - Ceruminous Glands that secrete ear wax aka Cerumen in the external ear canal
        - Smell in it deters insects
    - Mammary Glands are those that secrete milk

5.8

- Major function of skin:
    - Protection: 3 types of barriers
        - Chemical: acid skin secretions and melanin (sweat contains dermcidin and other antibacterial agents)
        - Physical: barrier to trauma and bacterial invasion, waterproofing too
        - Biological: Langerhans cells in epidermis and macrophages in dermis
    - Not impermeable to gases, fat-soluble vitamins& steroids, plan oleoresins, organic solvents, salts of heavy metals, penetration enhancing for drug administration
    - Body Temperature: sweating vasoconstriction
    - Cutaneous Sensation: temperature, texture, pain
    - Metabolic: Vitamin D, Carcinogens, Conversion of topically-applied cortisone to hydrocortisone

- Blood Reservoir: the dermal vascular supply can hold about 5% of the bodies total blood supply, so when the muscles need for blood rises, the nervous system constricts the blood vessels, the constriction shunts more blood to the general circulation making it available for those muscles
- Excretion: ammonia, urea, uric acid in sweat

5.9

- Burns can be caused by heat, electricity, radiation and chemicals
- The first concern is dehydration and the second is infection
- First degree burns are when the damage is only the epidermis, this twill repair itself
- Second degree burns are when the damage affects the epidermis and the upper dermis, this takes a couple weeks to heal
- Third degree burns are when the entire thickness of the skin is affected, so both the dermis and the epidermis
  - It cannot repair itself, only thing that can be done is skin grafting and the biggest issue with that is skin rejection
- The rule of nines allows us to estimate the volume of fluid lost due to a burn
  - It divided the body into 11 areas each accounting for 9% of the total body area and another area around the genitals accounting for one 1%