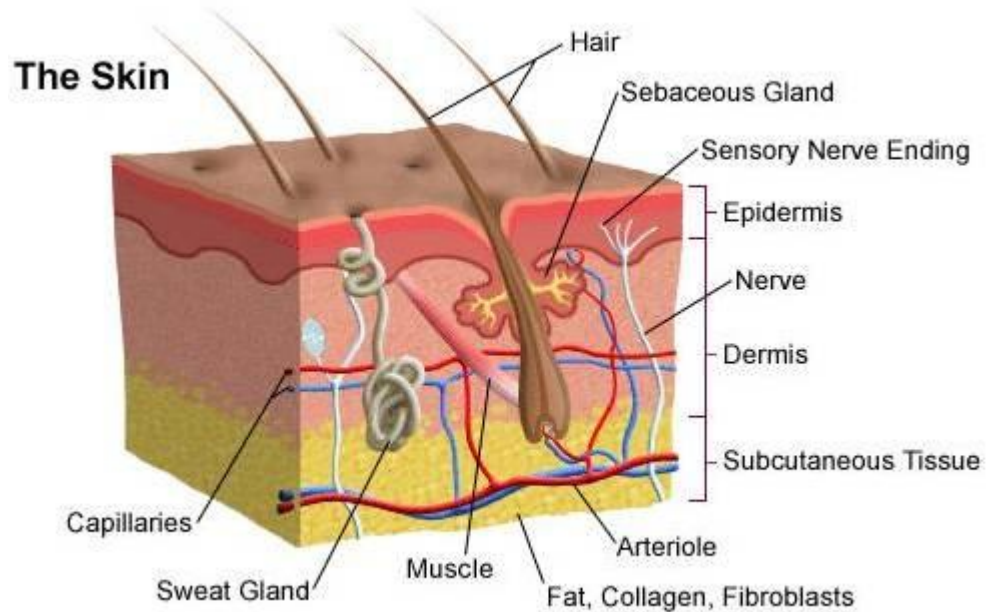


The Integumentary System - Training Handout

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National Rules Committee Chairman – Life Science

The **integumentary system** consists of the skin, hair, nails, the subcutaneous tissue below the skin, and assorted glands.



Functions of the Integumentary System

- Protection against injury and infection
- Regulates body temperature
- Sensory perception
- Regulates water loss
- Chemical synthesis

Protection – covers and protects the entire body against injury and infection

Physical barriers - continuity of the skin and hardness of keratinized cells

- Due to the skin's physical characteristics such as the keratinized cells and waterproofing properties of the glycolipids.
- Keratin helps waterproof the skin and protects from abrasions and bacteria
- Glycolipids prevent diffusion of water and water-soluble substances between cells
- Continuity prevents bacterial invasion
- Substances that are able to penetrate the skin:
 - Lipid-soluble substances (i.e., oxygen, carbon dioxide, steroids, and fat-soluble vitamins)
 - Oleoresins of certain plants (ex. poison ivy and poison oak)
 - Organic solvents (ex. acetone, dry cleaning fluid, and paint thinner)
 - Salts of heavy metals (ex. lead, mercury, and nickel)
 - Topical medications as motion sickness patch
- Penetration enhancers

Chemical barriers - (skin secretion and melanin)

- Skin secretions such as sebum, human defensins (antimicrobial peptides), acid mantle of the skin retards bacteria growth and/or kills them
- Melanin provides protection from UV damage

- Skin secretions (acid mantle)
- Low pH and sebum slow bacterial growth on skin surface
- Human defensin – natural antibiotic
- Cathelicidins – proteins that prevent Strep A infection in wounded skin
- Melanin – chemical pigment that prevents UV damage

Biological Barriers

- Langerhans' cells, macrophages, and DNA
- Langerhans' cells in epidermis present antigens to lymphocytes
- Dermal macrophages (2nd line of defense) – attack bacteria and viruses that have penetrated the epidermis
- Langerhan's cells and macrophages present in the skin helps activate the body's immune system.
- DNA structure – the electrons in DNA absorb UV radiation and converts it to heat

Temperature regulation

- Production of copious amounts of sweat to dissipate heat
- When body temperature rises and is hotter than the external environment the blood vessels in the dermal area dilates and sweat glands are stimulated into activity.
- Evaporation of the sweat from skin's surface helps dissipate heat from the body.
- Constriction of dermal blood vessels to retain heat
- When it is cold outside, the dermal blood vessels constrict and pull the blood away from the skin and keeps it close to the body core to protect crucial internal organs.

Cutaneous Sensations - cutaneous sensory receptors (see - nervous system)

- Meissner's corpuscles: light touch
- Merkel discs: light touch
- Pascinian receptors – lies in deeper dermis/hypodermis & detect deep pressure contacts
- Hair root plexus: sensations from movement of hairs
- Hair follicle receptors – movement across the surface of the skin
- Bare nerve endings: painful stimuli (chemicals, heat, cold)

Excretion/Absorption

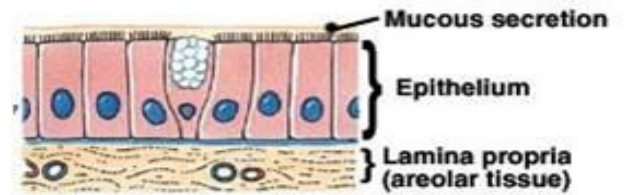
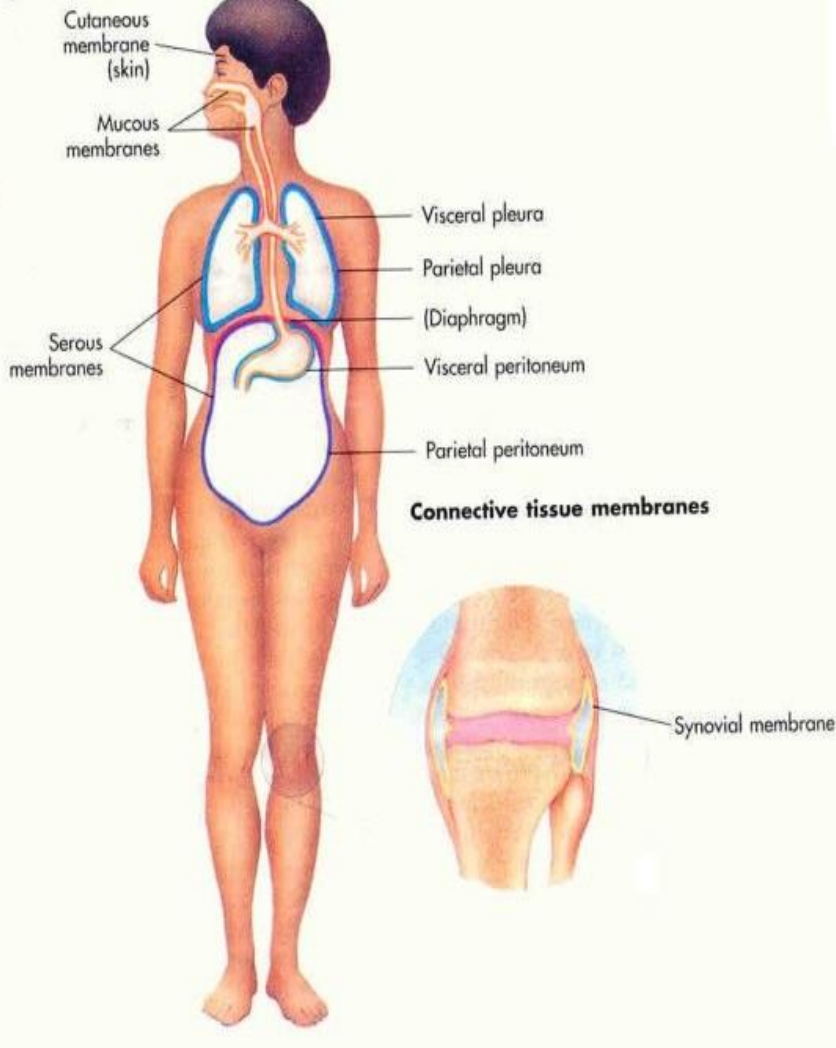
- Elimination of nitrogen-containing wastes (ammonia, urea, uric acid), sodium chloride, and water. It regulates water loss

Metabolic Functions

- Synthesis of Vitamin D – increases calcium absorption in the body
- Vitamin D is a fat-soluble vitamin that may be absorbed from the intestines or may be produced by the skin when the skin is exposed to ultraviolet light (particularly sunlight). It is converted to its active form by the body in 2 steps, occurring first in the liver and completed in the kidneys. In its active form, vitamin D acts as a hormone to regulate calcium absorption from the intestine and to regulate levels of calcium and phosphate in the bones. Vitamin D deficiency causes Rickets
- When the body is deficient in vitamin D, it is unable to properly regulate calcium and phosphate levels. If the blood levels of these minerals becomes low, the other body hormones may stimulate release of calcium and phosphate from the bones to the bloodstream.
- Chemical conversion of many substances
- Blood Reservoir – preferential shunting of blood as needed

Types of Membranes - thin sheet-like structures that protect parts of the body

Epithelial membranes



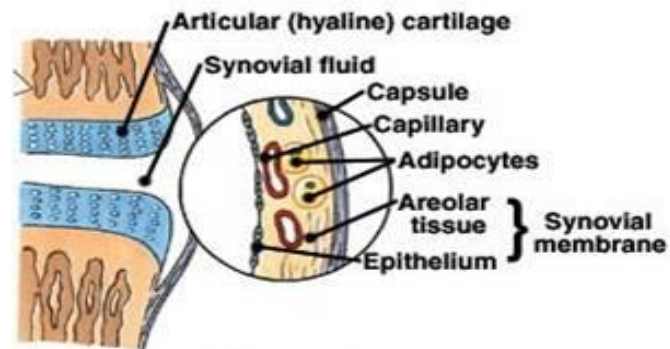
(a) Mucous membrane



(b) Serous membrane



(c) Cutaneous membrane



(d) Synovial membrane

Serous Membranes

- Line body cavities that have no opening to the outside
- Secrete a watery fluid called serous fluid that lubricates surfaces.

Mucous Membranes

- Line cavities and tubes that open to the outside

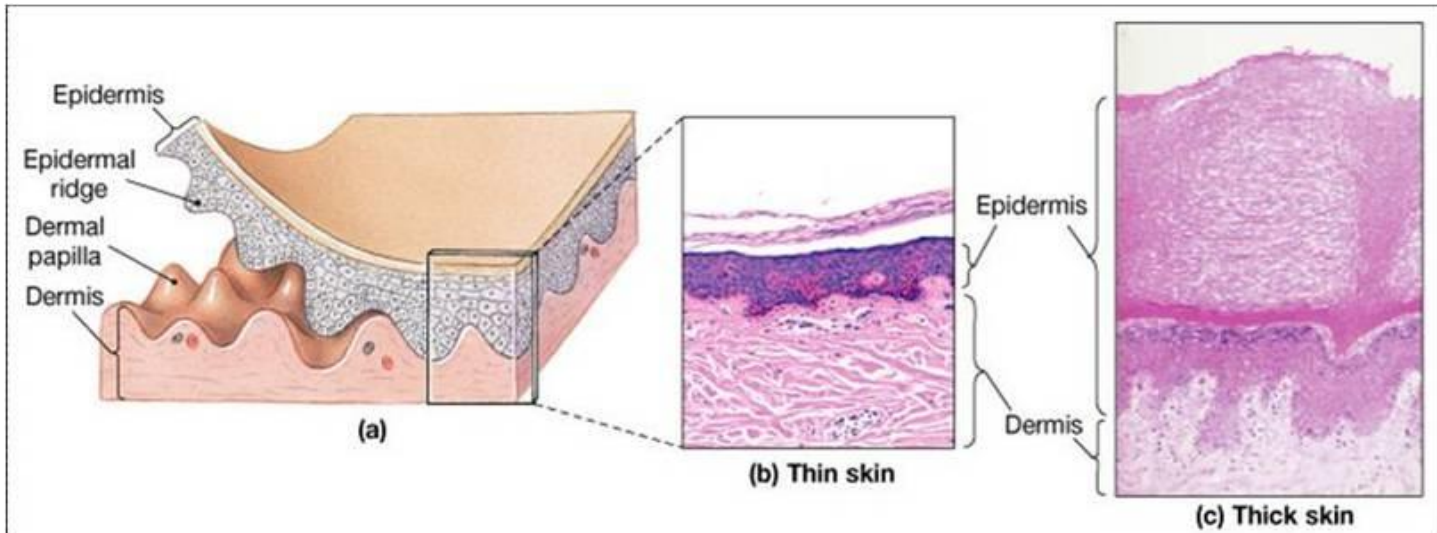
Synovial Membranes

- Form the inner lining of joint cavities
- Secrete a thick fluid called synovial fluid

Cutaneous Membrane – also known as skin

Characteristics of Skin

- The integument covers the entire body and is the largest organ ~ 2 meters and heaviest organ 16% of body mass of the body.
- Composed of the epidermis and dermis
- Pliable, yet durable
- Thickness: 1.5 to 6.0 mm



Types of Skin

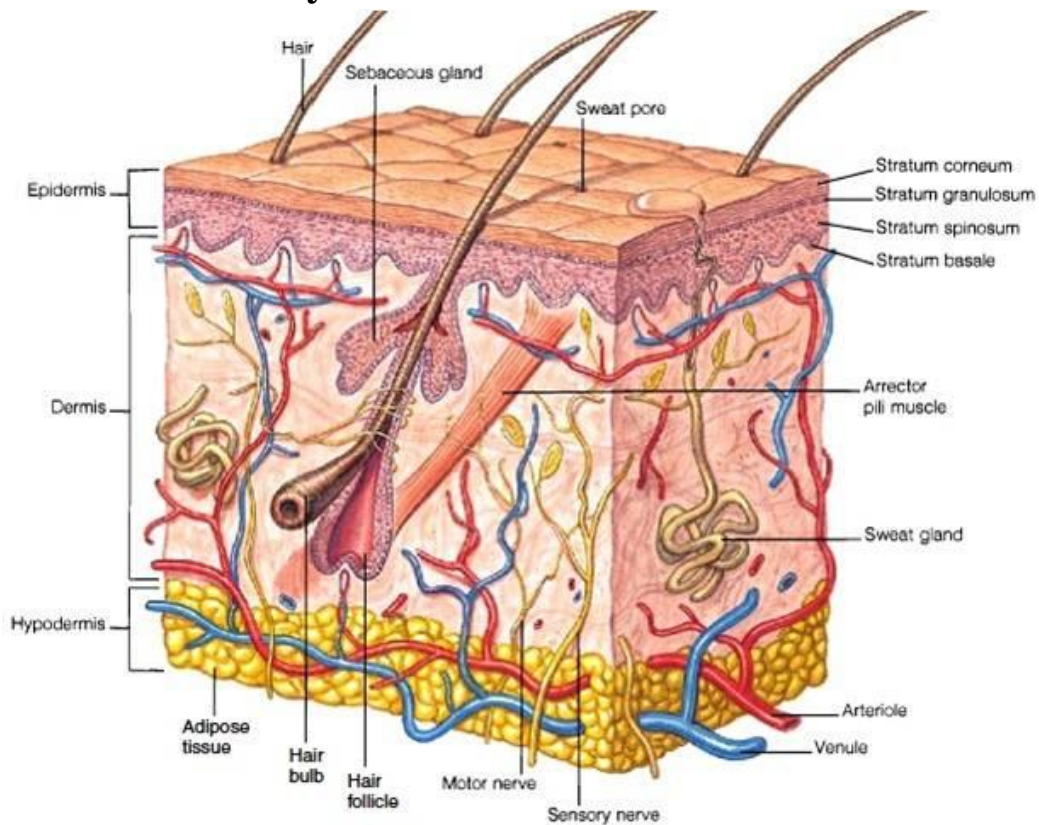
Thin - 1-2 mm on most of the body and 0.5 mm in eyelids

- Hairy
- Covers all parts of the body *except* palms of hands and soles of feet
- Thin epidermis and lacks stratum lucidum
- Lacks dermal papillae
- Has more sebaceous glands
- Fewer sweat glands, sensory receptors than thick skin

Thick - up to 6 mm thick on palms of hands and soles of feet

- Hairless
- Covers palms of hands and soles of feet
- Thick epidermis and a distinct stratum lucidum
- Epidermal ridges are present due to well-developed, numerous dermal papillae.
- Lacks sebaceous glands, has more sweat glands
- Sense receptors are also more densely packed.

Layers of the Skin



Epidermis

Types of Cells

Keratinocytes

- 90 % of epidermal cells are keratinized
- contains keratin (fibrous protein)
- protects and waterproofs the skin

Melanocytes

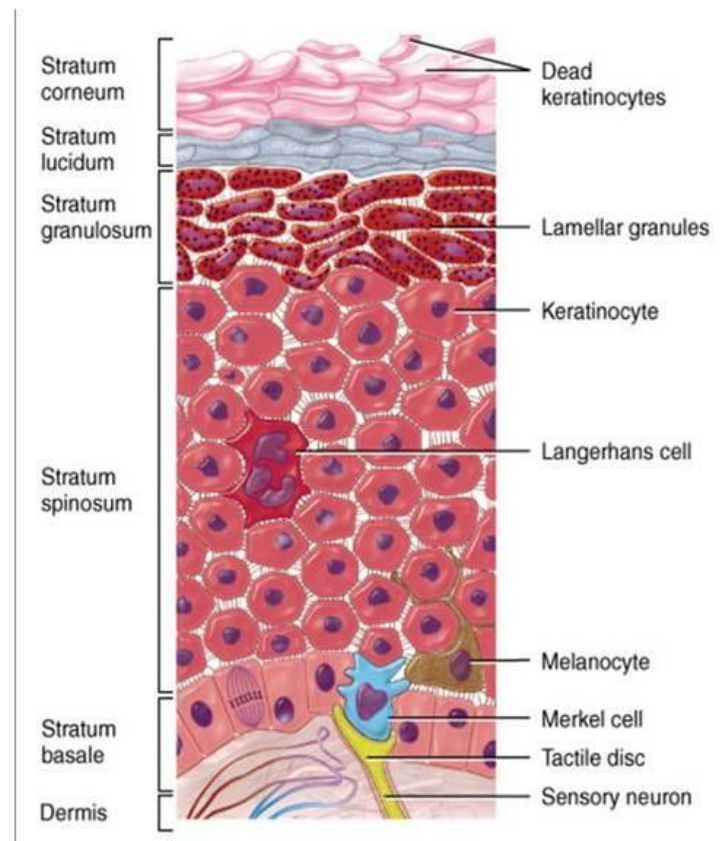
- 8% of the epidermal cells
- produces melanin
- contributes to skin color and absorbs UV light

Langerhans cells

- Arise from red bone marrow and migrate to the epidermis
- Constitute small portion of epidermal cells
- Participate in immune responses
- Easily damaged by UV light

Merkel cells

- Least numerous of the epidermal cells
- Found in the deepest layer of the epidermis
- Along with tactile discs, they function in sensation of touch



Layers of epidermis

Stratum corneum

- 25-30 layers of dead flat keratinocytes
- Shed continuously and replaced by cells from the deeper strata
- Serves as a water, microbe, injury barrier

Stratum lucidum

- Present only in *thick skin*
- 3-5 layers of clear, flat, dead keratinocytes
- Dense packed intermediate filaments
- Thick plasma membranes

Stratum granulosum

- Located above the stratum spinosum
- 3-5 layers of flattened keratinocytes undergoing apoptosis
- Organelles begin to disintegrate becomes non-living cells
- Marks the transition between deeper metabolically active strata and the dead cells of the superficial strata.
- Contains lamellar granules
- Secretes lipid-rich secretion that acts as a water sealant

Stratum spinosum

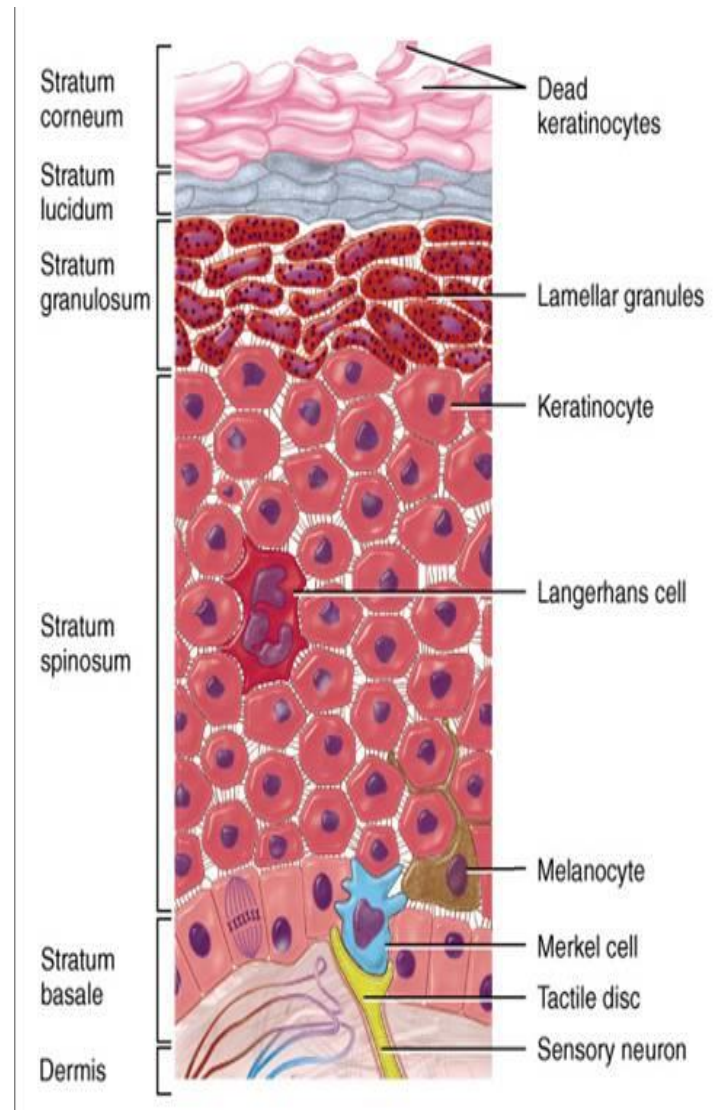
- Located above the stratum basale
- 8-10 layers of keratinocytes
- Some cells retain their ability for cell division
- Cells have spinelike projections (bundles of filaments of the cytoskeleton) tightly joins cells to each other.
- Provides skin both strength and flexibility

Stratum basale

- Also referred to as stratum germinatum because this is where new cells are formed
- Deepest layer of the epidermis
- Single row of cuboidal or columnar keratinocytes

Growth of epidermis

- Newly formed cells in the stratum basale undergo keratinization as they are pushed to the surface.
- They accumulate more keratin during the process
- Then they undergo apoptosis
- Eventually they slough off and are replaced
- The process takes about 4 weeks
- Rate of cell division in the stratum basale increases during injury



Dermis -

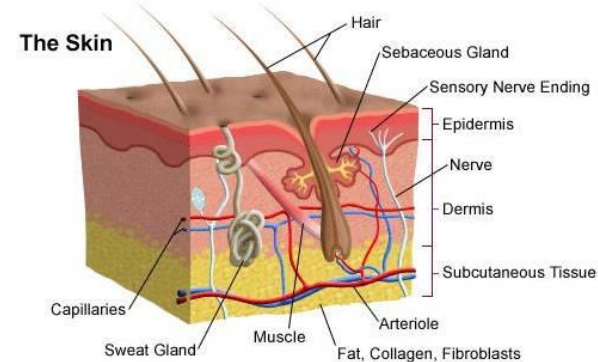
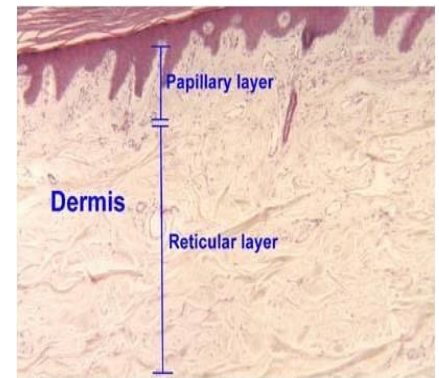
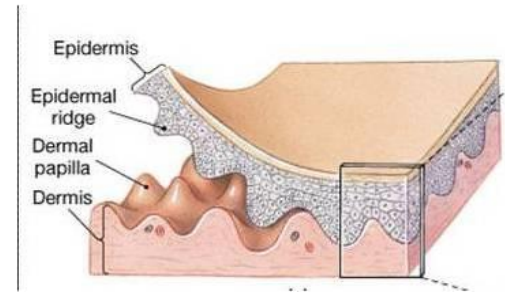
- Second deepest part of the skin
- Blood vessels, nerves, glands and hair follicles are embedded here
- Composed mainly of connective tissues (collagen and elastic fibers)
- Collagen fibers make up 70% of the dermis and give structural toughness and strength. Elastin fibers are loosely arranged in all directions and give elasticity to the skin
- Has two layers – Papillary Layer and Reticular layer.

Papillary layer

- Superficial portion of the dermis
- Consist of areolar connective tissue containing elastic fiber
- Surface area is increased due to projections called dermal papillae which contains capillaries or tactile receptors
- Epidermal ridges conforms to the dermal papillae

Reticular layer

- Deeper portion of the dermis
- Consist of dense irregular connective tissue containing collagen/elastic fibers
- Provides skin with strength and elasticity
- Contains hair follicles, nerves, sebaceous and sudoriferous glands



Hypodermis – (subcutaneous) Attaches the skin to underlying organs and tissues

- Not part of the skin - lies below the dermis
- Contains connective tissue and adipose tissues (subcutaneous fat) for insulation
- Infants and elderly have less of this than adults and are therefore more sensitive to cold

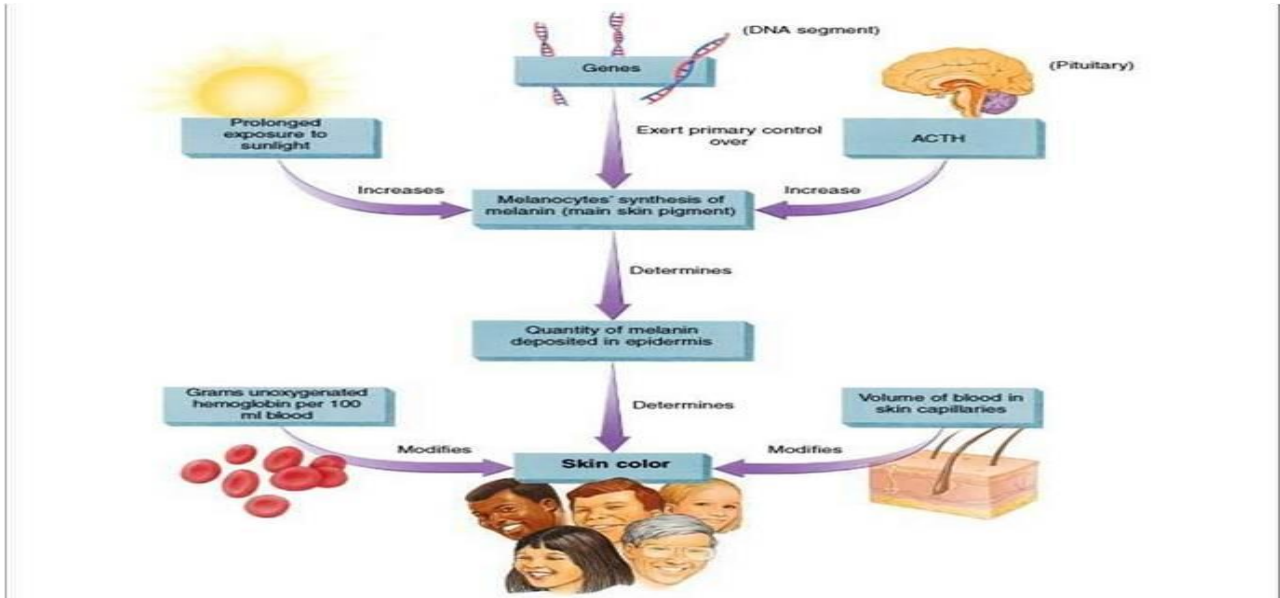
Skin Appearances

- Epidermis appears translucent when there is little melanin or carotene
- **White skin** appears pink to red depending on amount and oxygen content of blood moving in the capillaries of the dermis.
- **Albinism** is an inherited trait where a person can't produce melanin. They have melanocytes but are unable to make tyrosinase (the enzyme which initiates melanin production) so melanin is missing in their hair, eyes, and skin.
- Skin color as diagnostic clues for medical conditions
 - **Cyanotic** (cyan = blue) Ex: someone who has stopped breathing and the skin appears bluish because the hemoglobin is depleted of oxygen
 - **Jaundice** (jaund = yellow) - Buildup of bilirubin (yellow pigment) in the blood gives a yellowish appearance of eyes and skin indicating liver disease. Bilirubin is produced when red blood cells get old and are broken down by the body. Normally it is processed in the liver and then deposited in the intestine so it can come out in the stool.
 - **Erythema (ery = red)** - Engorgement of capillaries in the dermis indicating skin injury, infection, heat exposure, inflammation, allergies, emotional state, hypertension
 - **Pallor** - paleness, emotional state, anemia, low blood pressure

- **Bronzing** - Addison's disease, adrenal cortex

- **Bruising** (hematoma)- escaped blood has clotted hematomas , deficiency in Vitamin C or hemophilia
- **leathery skin** - overexposure clumping of elastin fibers depressed immune system
- can alter DNA to cause skin cancer
- **photosensitivity** - to antibiotics & antihistamines

○ **Skin Color** – genetic factors, environmental factors and volume of blood



Skin Pigments - three pigments are responsible for skin color- melanin, carotene, hemoglobin

Melanin

- Located mostly in epidermis
- Number of melanocytes are about the same in all races
- Difference in skin color is due to the amount of pigment that melanocytes produce and disperse to keratinocytes.
- Freckles are caused by the accumulation of melanin in patches
- Liver spots are also caused by the accumulation of melanin
- Melanocytes synthesize melanin from an amino acid called tyrosine along with an enzyme called tyrosinase. All this occurs in the melanosome which is an organelle in the melanocyte.
- Two types of melanin: eumelanin which is brownish black and pheomelanin which is reddish yellow
- Fair-skinned people have more pheomelanin and dark skinned people have more eumelanin

Environmental Factors

- UV light increases enzymatic activity in the melanosomes and leads to increased melanin production.
- A tan is achieved because the amount of melanin has increased as well as the darkness of the melanin. (Eumelanin provides protection from UV exposure while pheomelanin tends to break down with too much UV exposure)
- The melanin provides protection from the UV radiation but prolonged exposure may cause skin cancer.

Carotene (carot = carrot)

- yellow-orange pigment
- precursor for Vitamin A which is used to make pigments needed for vision
- found in stratum corneum and fatty areas of dermis and hypodermis layer

Hemoglobin

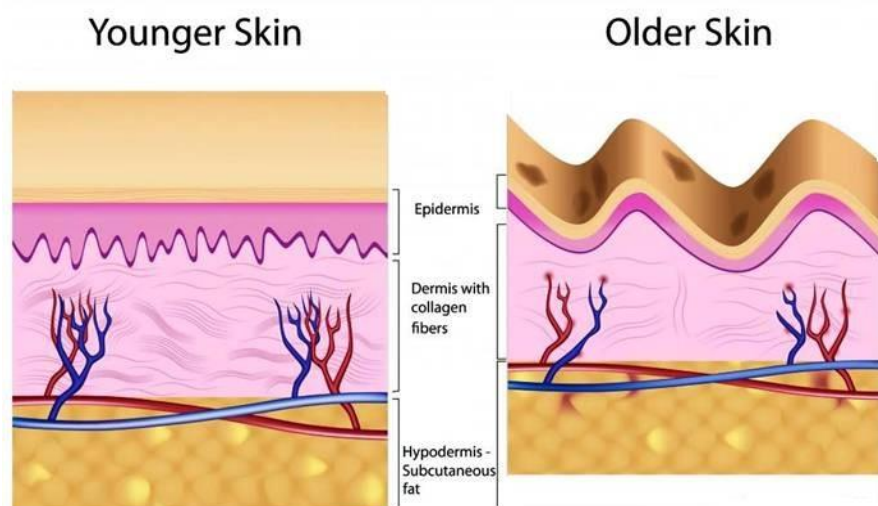
- Oxygen-carrying pigment in red blood cells

Skin Markings - skin is marked by many lines, creases and ridges

- **friction ridges:** markings on fingertips characteristic of primates
- allow us to manipulate objects more easily - **fingerprints** are friction ridge skin impressions
- **flexion lines:** on flexor surfaces of digits, palms, wrists, elbows etc skin is tightly bound to deep fascia at these points
- **freckles:** flat melanized patches vary with heredity or exposure to sun
- **moles:** elevated patch of melanized skin, of the with hair mostly harmless, beauty marks

Aging

- Beginning in our 20s, the effects of aging begin to be visible in the skin.
- Stem cell activity declines: skin thin, repair difficult
- Epidermal dendritic cells decrease: reduced immune response
- Vitamin D3 production declines: calcium absorption declines and brittle bones
- Glandular activity declines: skin dries, body can overheat
- Blood supply to dermis declines: tend to feel cold
- Hair follicles die or produce thinner hair
- Dermis thins and becomes less elastic – wrinkles
- Sex characteristics fade: fat deposits spread out, hair patterns change
- Genetically programmed chronologic aging causes biochemical changes in collagen connective tissues that give skin its firmness and elasticity.
- The genetic program for each person is different, so the loss of skin firmness and elasticity occurs at different rates and different times in one individual as compared with another.
- As skin becomes less elastic, it also becomes drier.
- Underlying fat padding begins to disappear.
- With loss of underlying support by fat padding and connective tissues, the skin begins to sag. It looks less supple and wrinkles form.
- The skin may be itchy with increased dryness. A cut may heal more slowly.



Derivatives of skin - during embryonic development thousands of small groups of epidermal cells from stratum basale push down into dermis to form hair follicles and glands

Skin receptors:

Your skin and deeper tissues contain millions of sensory receptors. Most of your touch receptors sit close to your skin's surface.

Light touch

- *Meissner's corpuscles* are enclosed in a capsule of connective tissue
- They react to light touch and are located in the skin of your palms, soles, lips, eyelids, external genitals and nipples
- These areas of your body are particularly sensitive

Heavy pressure

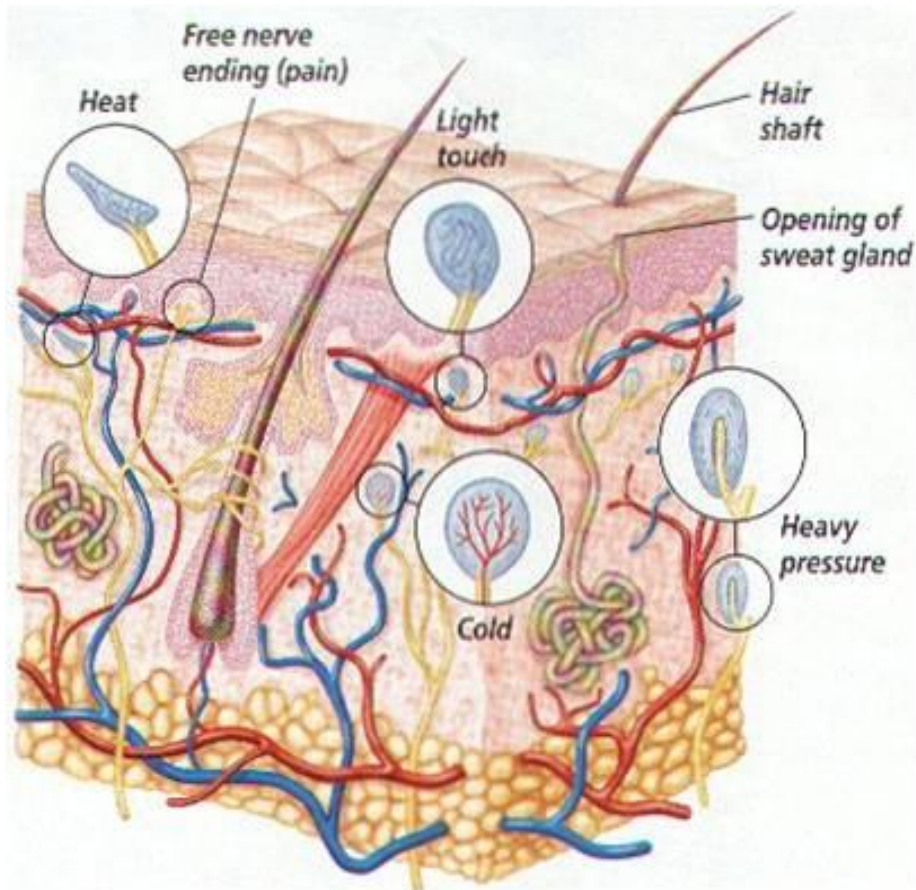
- *Paccinian corpuscles* sense pressure and vibration changes deep in your skin.
- Every square centimeter of your skin contains around 14 pressure receptors

Pain

- skin receptors register pain
- pain receptors are the most numerous
- each square centimeter of your skin contains around 200 pain receptors

Temperature

- Skin receptors register warmth and cold
- Each square centimeter of your skin contains 6 receptors for cold and 1 receptor for warmth
- *Cold receptors* start to perceive cold sensations when the surface of the skin drops below 95 ° F. They are most stimulated when the surface of the skin is at 77 ° F and are no longer stimulated when the surface of the skin drops below 41 ° F. This is why your feet or hands start to go numb when they are submerged in icy water for a long period of time.
-
- *Hot receptors* start to perceive hot sensations when the surface of the skin rises above 86 ° F and are most stimulated at 113 ° F. Beyond 113 ° F, pain receptors take over to avoid damage being done to the skin and underlying tissues.
- *Thermoreceptors* are found all over the body, but cold receptors are found in greater density than heat receptors – most of the time our environment is colder than our body temperature
- The highest concentration of thermoreceptors can be found in the face and ears so your nose and ears always get colder faster than the rest of your body on a chilly winter day



Accessory Structures of the Skin

Hair

Anatomy of Hair Follicle

Shaft: portion of hair that projects from skin surface

- Straight hair has a round shaft
- Curly hair is oval

Root: portion of hair deep to the shaft penetrating the dermis

- Has **3 layers**:
 - **medulla:** contains pigment granules and air spaces
 - **cortex:** middle layer in dark hair contains pigment in gray or white hair contains air bubbles
 - **cuticle:** outer layer heavily keratinized cells that lie like shingles

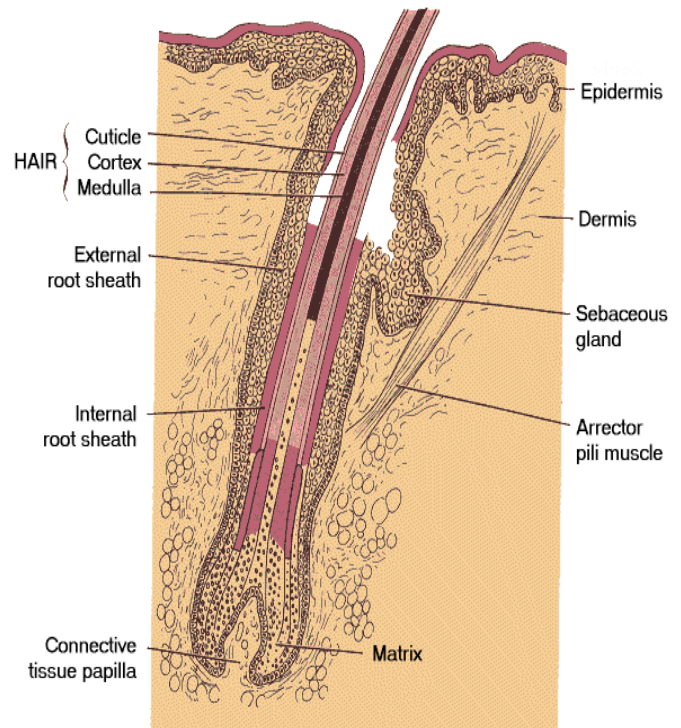
Base of the hair follicle

- **Bulb:** houses the papilla which contains the blood vessels that nourishes the growing hair follicle.
- **Matrix:** responsible for hair growth and produces new hair

Arrector pili: smooth muscle

- Extends from the dermis to the side of hair follicle.
- Hair grows at an angle to the surface of the skin
- Arrector pili muscles contract and pulls hair straight causing **goose bumps**.

Hair root plexus - dendrites of neurons which are sensitive to touch



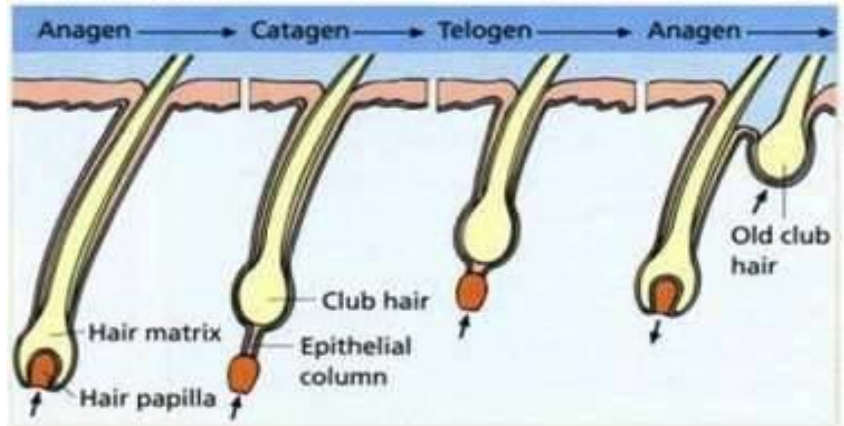
Important Features and Texture

- Roughly 5 million hairs cover the body of an average individual
- About 100,000 are on the scalp
- Almost every part of body is covered with hair except palms of hands, soles of feet, sides of fingers and toes, lips and parts of genitals.
- Hair shafts differ in size, shape, and color. In the eyebrows they are short and stiff while on the scalp they are longer and more flexible. Over the rest of the body they are fine and nearly invisible
- Oval shaped hair shafts produce wavy hair, flat or ribbon-like hair shafts produce curly or kinky hair, and round hair shafts produce straight hair.



The Hair Growth Cycle

- Hair follicles grow in repeated cycles.
- One cycle can be broken down into three phases.
 1. **Anagen** - Growth Phase
 2. **Catagen** – Transitional Phase
 3. **Telogen** - Resting Phase
- Each hair passes through the phases independent of the neighboring hairs



Anagen Phase - Growth Phase

- Approximately 85% of all hairs are in the growing phase at any one time. The Anagen phase or growth phase can vary from two to six years. Hair grows approximately 10cm per year and any individual hair is unlikely to grow more than one meter long. Each hair on your body grows from its own individual hair follicle. Inside the follicle, new hair cells form at the root of the hair shaft. As the cells form, they push older cells out of the follicle. As they are pushed out, the cells die and become the hair we see.
- A follicle will produce new cells for a certain period of time depending on where it is located on your body. This period is called the growth phase.

Catagen Phase - Transitional Phase

- At the end of the Anagen Phase the hair enters into a Catagen Phase which lasts about one or two weeks, during the Catagen Phase the hair follicle shrinks to about 1/6 of the normal length.
- The lower part is destroyed and the dermal papilla breaks away to rest below.

Telogen Phase - Resting Phase

- The Resting Phase follows the Catagen Phase and normally lasts about 5-6 weeks. During this time the hair does not grow but stays attached to the follicle while the dermal papilla stays in a resting phase below. Approximately 10-15 percent of all hairs are in this phase at any one time.
- When the hair follicle enters the **Resting Phase**, the hair shaft breaks, so the existing hair falls out and a new hair takes its place. Therefore, the length of time that the hair is able to spend growing during the growth phase controls the maximum length of the hair.
- The cells that make the hairs on your arms are programmed to stop growing every couple of months, so the hair on your arms stays short. The hair follicles on your head, on the other hand, are programmed to let hair grow for years at a time, so the hair can grow very long.
- Animals that shed have hair follicles that synchronize their rest phase so that all of the follicles enter the rest phase at once.
- Some factors that affect the rate of growth and replacement of hair are illness, diet, stress, gender, radiation therapy, and medication.
- At the end of the Telogen phase the hair follicle re-enters the Anagen Phase. The dermal papilla and the base of the follicle join together again and a new hair begins to form. If the old hair has not already been shed the new hair pushes the old one out and the growth cycle starts all over again.

Functions of Hair

- Hair on the head protects scalp from injury and sunlight
- Eyelashes and eyebrows protect eyes
- Nostril and ear hairs protect from foreign particles
- Help in sensing light touch due to the touch receptors associated with the hair root plexuses.

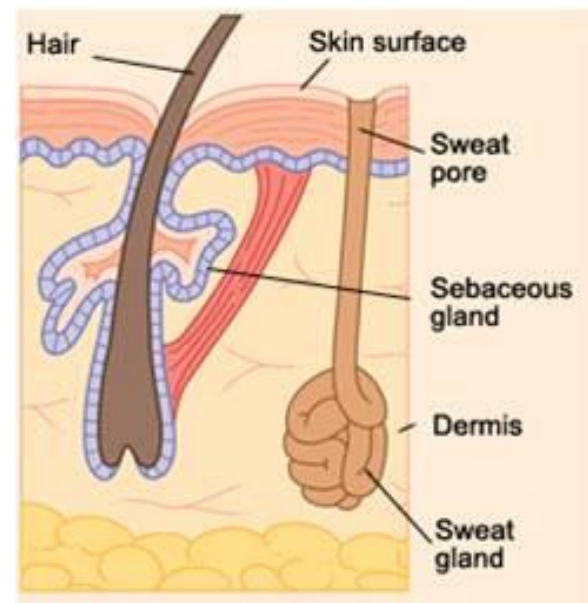
Hair Color

- Hair color is due to amount and type of melanin in the keratinized cells.
- Melanocytes in the matrix of the bulb synthesizes melanin.
- Melanin passes into the cortex and medulla of the hair.
- **Dark hair** contains true melanin
- **Blond and red hair** have variants of melanin in which there is iron/sulfur.
- **Gray hair results from a** decline in tyrosinase (enzyme which initiates melanin production).
- **White hair** results from the accumulation of air bubbles in the medullary shaft.

Skin Glands

Sudoriferous - sweat glands (sudori = sweat) (ferous = bearing)

- 3- 4 million glands in your body empties onto the skin thru pores or into hair follicles
- Two main types of sweat glands
- **Eccrine sweat glands**
 - Secretes cooling sweat
 - Secretes directly onto the skin
 - Began to function soon after birth
 - Sweat is composed of 98 percent water and two percent dissolved salts and nitrogenous wastes, such as urea and uric acid
 - Helps regulate body temperature/aids in waste removal
- **Apocrine sweat glands**
 - Stimulated during emotional stress/excitement
 - Secretes into hair follicle
 - Begins to function at puberty
 - Slightly more viscous than eccrine secretions
 - Composed of the same components as eccrine sweat plus
 - lipids and proteins.
 - Referred to as “cold sweat”.



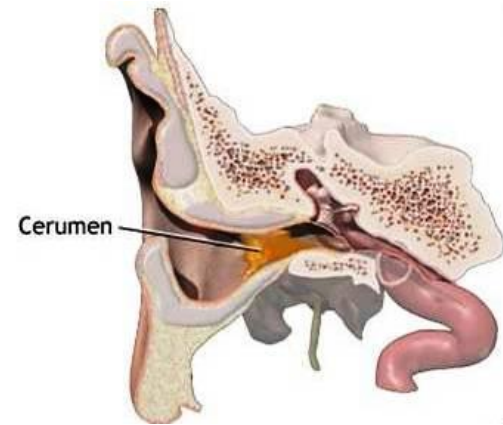
Sebaceous - oil glands (sebase = grease)

- They are mostly connected to hair follicles.
- Sebaceous glands are embedded in the dermis over most of the body.
- Absent in the palms and soles.
- Vary in size, shape and numbers in other areas of the body.
- Secrete an oily substance called sebum. which lubricates the hair and skin
- Mixture of fats, cholesterol, proteins, inorganic salts, pheromones.
- Coats surface of hair
- Prevents excessive evaporation of water from skin

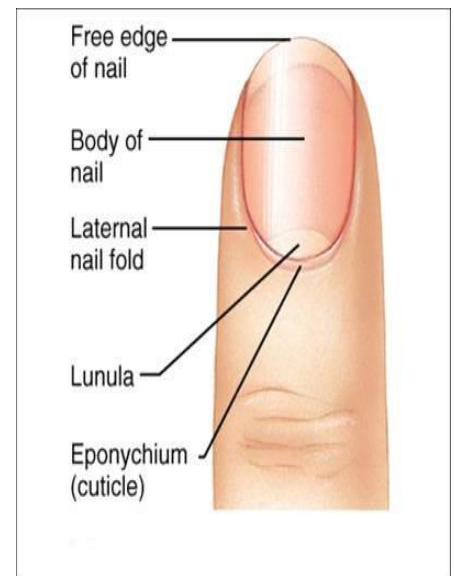
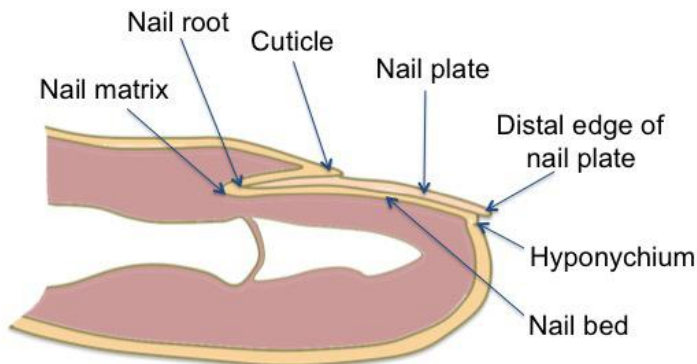
- Keeps skin soft and pliable
- Inhibits growth of some bacteria.
- Sebaceous gland activity increases with puberty, due to the male and female hormone activity
- Accumulation of sebum in the ducts = white pimples – if the sebum darkens -black heads form
- **Acne** - inflammation of sebaceous gland ducts

Ceruminous - modified sweat glands of the external ear that produce ear wax (cer = wax)

- Open directly onto the surface of the external auditory canal (ear canal) or into ducts of sebaceous glands.
- Earwax is the combination of secretion of ceruminous and sebaceous glands.
- Earwax and the hair combine to provide a sticky barrier against foreign items.



Nails



- Made of tightly packed, hard, keratinized epidermal cells
- Consist of:
 - Nail body:** portion of the nail that is visible
 - Free edge: part that extends past the distal end of the digit
 - Nail root: portion buried in a fold of skin
 - Lunula** : means little moon
 - Crescent shaped area of the nail
 - Hyponychium:** secures the nail to the fingertip
 - Thickened stratum corneum
 - Eponychium or cuticle:** narrow band of epidermis
 - Growth of nails is in the nail matrix.

- Nail cells multiply under the skin. Each cell keeps dividing and creating more cells. The new cells push the old cells above the skin surface.
- Once the nail cells are out on the surface, they are pushed from below by new nail cells, towards your finger or toe. However, once they come out they lose the ability to multiply. They become dead cells.
- **Functions of the nails:**
 - Grasping objects
 - Manipulating objects
 - Protects ends of digits from trauma
 - Scratching

Imbalances of Homeostasis

Skin Imbalances - The skin can develop >1000 different ailments. the most common skin disorders result from allergies or infections less common are burns and skin cancers

Skin lesions – any measurable variation from normal structure of the skin

- **Elevated lesions** – cast a shadow outside the edges as warts, plaque, blister
- **Flat lesions** – do not cast a shadow as a scab, elevated lesion with pus, hive
- **Depressed lesions** – cast a shadow within their edges as lacerations, ulcers, fissures

Infections

- **Viral** - eg. cold sores, herpes simplex especially around lips and oral mucosa
Warts – benign neoplasms caused by papillomavirus (HPV)
- **Fungal** - eg. athletes foot, Tinea
- **Bacterial**- eg. boils and carbuncles inflammation of hair follicle and sebaceous glands especially on face or dorsal side of neck , impetigo *Streptococcus* infection

Contact dermatitis is a condition in which the skin becomes red, sore, or inflamed after direct contact with a substance. There are two kinds of contact dermatitis: **irritant or allergies**

Irritant dermatitis is the most common type. It's caused by contact with acids, alkaline materials such as soaps and detergents, fabric softeners, solvents, or other chemicals. The reaction usually looks like a burn.

Other irritants may include:

- Cement
- Hair dyes
- Long-term exposure to wet diapers
- Pesticides or weed killers
- Rubber gloves
- Shampoos

Allergic contact dermatitis is caused by exposure to a substance or material to which you have become extra sensitive or allergic.

Common allergens include:

- Adhesives, including those used for false eyelashes or toupees
- Antibiotics such as neomycin rubbed on the surface of the skin
- Balsam of Peru (used in many personal products and cosmetics, as well as in many foods and drinks)
- Fabrics and clothing
- Fragrances in perfumes, cosmetics, soaps, and moisturizers
- Nail polish, hair dyes, and permanent wave solutions
- Nickel or other metals (found in jewelry, watch straps, metal zips, bra hooks, buttons, pocketknives, lipstick holders, and powder compacts)
- Poison ivy, poison oak, poison sumac, and other plants
- Rubber or latex gloves or shoes

Treatment

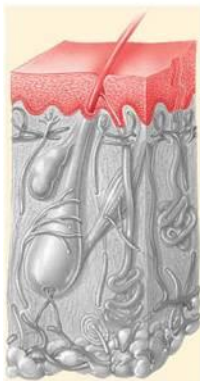
- Washing with lots of water to remove any traces of the irritant that may remain on the skin
- Avoid further exposure to known irritants or allergens
- Anti-itch (antipruritic) or drying lotions may be recommended to reduce other symptoms
- Corticosteroid skin creams or ointments may reduce inflammation
- Corticosteroid pills or a corticosteroid shot from the doctor may be needed in severe cases

Genetic Diseases

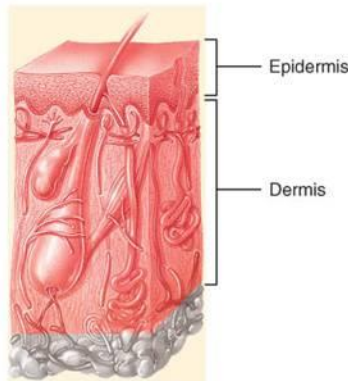
- **Psoriasis**
 - chronic, noninfectious skin disease
 - skin becomes dry and scaly, often with pustules and many varieties
 - cycle of skin cell production increases by 3-4x's normal
 - stratum corneum gets thick as dead cells accumulate
 - seems to be a genetic component
 - often triggered by trauma, infection, hormonal changes or stress
- **Vitiligo** – a autoimmune pigmentation disorder where melanocytes in the epidermis are destroyed eg Michael Jackson



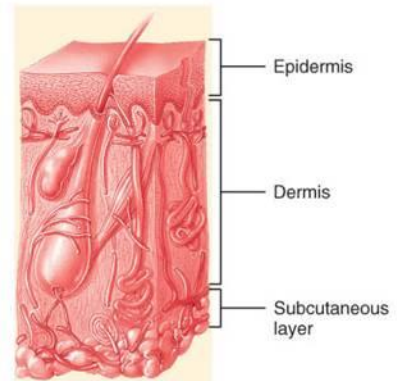
Burns - too much sunlight or heat - categorized by degree of penetration of skin layer



(a) First-degree burn (sunburn)



(b) Second-degree burn (note the blister)



(c) Third-degree burn

- **1st degree burns**
 - skin is inflamed, red - surface layer of skin is shed
- **2nd degree burns**
 - deeper injury - blisters form as fluid builds up beneath outer layers of epidermis
- **3rd degree burns**
 - full thickness of skin is destroyed -sometimes even subcutaneous tissues results in ulcerating wounds
 - typically results in catastrophic loss of fluids:
 - dehydration
 - electrolyte imbalances
 - also highly susceptible to infections
 - slow recovery (from cells of hair follicles if they survive; otherwise must heal from margins of wound)
 - may require: autografts, cadaver skin, pig skin
 - prognosis may depend on extent of damage
- A **fourth- degree burn** additionally involves injury to deeper tissues, such as muscle or bone

“**rule of 9’s**”- extend of burn damage estimated by

- head, arms ~9% of skin surface
- front and back of torso, each leg ~18% of skin surface
- groin ~1% of skin surface

Skin Cancer

- Cells have a built-in mechanism that causes contact inhibition. Healthy cells stop growing when they come in contact with one another. In damaged cells, contact inhibition is lost and therefore the cells continue to grow until they start lumping up on one another.
- Cancer cells do not exhibit contact inhibition.
- Excessive or chronic exposure UV radiation , x-rays or radiation' chemicals or physical trauma are predisposing factors to cancer.
- most forms progress slowly and are easily treated but a few are deadly



Basal Cell Carcinoma

- least malignant
- most common -78% of all skin cancers
- stratum basale can't form keratin
- lose boundary layer between epidermis and dermis
- results in tissue erosion and ulceration
- 99% of these cancers are fully cured

Squamous Cell Carcinoma -20% of all skin cancers

- cancer of the cells in stratum spinosum
- arise from squamous cells of the epidermis
- usually induced by sun
- cells grow rapidly and grow into the lymphatic tissues
- hardened small red growth
- spreads rapidly if not removed
- good chance of recovery if detected and treated early

Malignant Melanoma

- cancer of pigment cells = melanocytes
- rare ~1% of skin cancers
- deadly, poor chance of cure once it develops
- often begins with moles
- spreads rapidly
- early detection and treatment is the key to survival