INTEGUMENTARY SYSTEM

Skin and its Appendages
considered an organ or an organ system

body’s largest organ

organ of greatest surface area: 15-20 sq ft. (1.5-2 m²)
PURPOSES

1. protection
   + mechanical
   + chemical
   + bacterial
   + UV
   + Desiccation
2. **temperature homeostasis**
   - >temp ‡ sweat glands, flushing
   - <temp ‡ arrector pili cause hairs to stand up on end, pale

3. **excretion**
   - affects fluid & electrolyte balance
   - sweat glands release: water, salts, ammonia
   - oil glands release: lipids, acids

4. **sensation**
   - touch (light touch, wind, etc)
   - pressure
   - heat
   - cold
   - pain
5. synthesis
+ vitamin D precursor passes through capillaries in skin and light converts it to vitamin D

6. nonverbal communication
+ eg. humans and other primates have much more expressive faces than other animals
LAYERS OF SKIN

- Epidermis
  - stratified squamous epithelium
  - upper layers dead, filled with keratin (waxy protein)
  - lower layers living cells
  - replaced every 35-45 days
Dermis

- strong, flexible, connective tissue
- gives skin its strength and resilience
- gel-like matrix
- contains collagen, elastic and reticular fibers
- rich in nerves, receptors, blood vessels, lymph vessels
- hair follicles and sweat glands extend into it
Subcutaneous

- Aka: hypodermis or superficial fascia
- below skin
- mainly adipose tissue (ie subcutaneous fat)
- insulation
- infants and elderly have less of this than adults and are therefore more sensitive to cold
SKIN COLOR

- due to combination of three different pigments:
  - **melanin**
    - yellow, orange, brown or black pigments
    - racial shades due mainly to kinds and amount of melanin pigments
    - also, amount varies with exposure to sun=suntan
  - **carotene**
    - esp in stratum corneum and subcutaneous layers
    - Orange in color
  - **hemoglobin**
    - in blood of skin capillaries
SKIN COLOR & TEXTURE IN DIAGNOSIS

- **cyanosis** = bluish cast ‡ poor oxygenation
- **erythema** = redness ‡ emotional, hypertension, inflammation
- **pallor** = paleness ‡ emotion, anemia, low blood pressure
- **jaundice** = yellowing ‡ liver disorder, >bile pigments in blood
- **bronzing** = Addison’s disease, adrenal cortex
- **bruising** (hematoma) = escaped blood has clotted
- **hematomas** ‡ deficiency in Vit 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 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
- **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
“DERIVATIVES OF SKIN”

1. Hair
   - covers entire body except palms, soles, lips, nipples, parts of external genitals
   - hormones account for the development of “hairy” regions:
     eg. head, axillary and pubic areas
   - humans are born with as many follicles as they will ever have
   - hairs are among the fastest growing tissues in the body
   - formation similar to epidermis
   - heavily **keratinized** (structural protein)
PARTS OF HAIR

- **shaft**: visible part
- **root**: 
- **follicle**: sheath surrounding root
- **papillae**: vascularized, growing part of hair
- **Arrector Pili muscles**
  + attached to follicle
  + causes hair to stand on end (cold, fright)
- **oil glands**
- **hair receptor**: entwines each follicle, responds to hair movements
- **hair color** depends on kinds (yellow, rust, brown, and black) and the amount of melanin cortex of shaft contains
- **hair texture** related to differences in cross-sectional shape (straight hair is round and curly hair is flat (think curling ribbon))
NAILS

- scale-like modification of the epidermis
- fingernails and toenails are clear and hard
- very thin, dead, scaly cells, densely packed together
- corresponds to hoof or claw of other animals
- most mammals have claws
- flat nails are a primate characteristic
  - more fleshy and sensitive fingertips
  - still can be used for digging and picking apart food, etc
**NAIL FEATURES**

- **nail matrix:** growth zone beneath proximal skin
  - nail bed composed of stratum basale

- **nail plate:** visible portion of nail
  - fingernails grow ~1 mm/wk; toenails more slowly
    - [adding gelatin to diet has no effect on growth or hardness of nails]

- appearance of nails has diagnostic value:
  - eg. spoonlike, flat, concave -- may indicate iron deficiency
  - eg. clubbed or swollen fingertips -- long term hypoxemia from eg congenital heart defects and emphysema
SKIN GLANDS

- **Oil glands (Sebaceous Glands, holocrine)**
  - 2 or more per follicle
  - keeps hair soft and pliable esp on face and scalp
  - not on palms, soles or dorsal side of feet
  - reduces heat loss
  - lipids are poor heat conductors
  - helps prevent water evaporation
  - become active at puberty ✫ acne
  - secrete **sebum** = breakdown products of dead cells
Sweat Glands (sudoriferous)(eccrine glands)

- ~3 Million total on skin
- ~3000 sweat glands/inch\(^2\)
- most numerous on palms, soles, forehead, armpits
- essentially a tiny coiled tube that opens to skin surface
- helps maintain temperature and fluid/electrolyte balance
- \(\dagger \) heat = sweat = evaporative cooling
Scent Glands (apocrine glands)

- modified sweat glands ‡ scent, pheromones
- much less common
- confined to axillary and genital area
- their ducts empty into hair follicles
- secretions contain fatty acids and proteins in addition to “sweat”
- respond especially to stress and sexual stimulation
- **Mammary Glands**
  - modified sweat glands
  - produce milk

- **Ceruminous Glands**
  - modified sweat glands
  - in external ear canal
  - secrete waxy pigmented cerumin
  - Protection: traps dust and particles
Ailments

- The skin can develop >1000 different ailments.
- The most common skin disorders result from allergies or infections.
- Less common are burns and skin cancers.
- A. Allergies
  - Contact Dermatitis
  - Allergic response
  - Eg. poison ivy, metals, etc.
B. Infections

1. viral
   - eg. cold sores
   - herpes simplex especially around lips and oral mucosa

2. Fungal
   - eg. athletes foot

3. Bacterial
   - ex. boils and carbuncles
     - inflammation of hair follicle and sebaceous glands
     - esp on dorsal side of neck
   - ex. impetigo
     - *Streptococcus* infection
C. Genetic Diseases

1. Psoriasis
   - chronic, noninfectious skin disease
   - skin becomes dry and scaly,
   - often with pustules
   - 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

2. Hypertrichosis (human werewolves)
   - patients show dense hair growth on faces and upper bodies
   - due to malfunction of gene on x chromosome
   - a gene silenced during evolution has been reactivated
D. Burns

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

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
extent of burn damage estimated by “rule of 9’s”

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

Head, back, and chest is 45% (9% + 18% + 18%)
E. Skin Cancer

- caused by excessive or chronic exposure to UV, x-rays or radiation
- most forms progress slowly and are easily treated
- a few are deadly
1. Basal Cell Carcinoma

- least malignant
- most common
- 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
2. Squamous Cell Carcinoma

- cancer of the cells in stratum spinosum
- usually induced by **sun or tanning beds**
- cells grow rapidly and grow into the lymphatic tissues
3. Malignant Melanoma

- cancer of pigment cells = melanocytes
- rare ~1% of skin cancers
- deadly, poor chance of cure once it develops
- often begins with moles
Ultraviolet radiation (UVR) is a proven human carcinogen, yet on an average day, more than one million Americans use tanning salons.

Frequent tanners using new high-pressure sunlamps may receive as much as 12 times the annual UVA dose compared to the dose they receive from sun exposure.

Just one indoor tanning session increases users’ chances of developing melanoma by 20 percent, and each additional session during the same year boosts the risk almost another two percent.

Among people ages 18 to 29 who have ever used a tanning bed and were diagnosed with melanoma, 76 percent of those melanoma cases were attributable to tanning bed use.

People who tan indoors just four times per year increase their risk of basal cell carcinoma and squamous cell carcinoma by 15 percent.

Just one indoor tanning session per year in high school or college boosts the risk of basal cell carcinoma by 10 percent. That risk is increased to 73 percent if one tans six times per year.

People who first use a tanning bed before age 35 increase their risk for melanoma by 75 percent.

Ten minutes in a sunbed matches the cancer-causing effects of 10 minutes in the Mediterranean summer sun.

Seventy-one percent of tanning salon patrons are females.
The overall 5-year melanoma survival rate for African Americans is only 77 percent, versus 91 percent for Caucasians.

Skin cancer represents approximately two to four percent of all cancers in Asians.

Melanomas in African Americans, Asians, Filipinos, Indonesians, and native Hawaiians most often occur on non-exposed skin with less pigment, with up to 60-75 percent of tumors arising on the palms, soles, mucous membranes and nail regions.

Basal cell carcinoma (BCC) is the most common cancer in Caucasians, Hispanics, Chinese Asian and the Japanese.

Squamous cell carcinoma (SCC) is the most common skin cancer among African Americans and Asian Indians.

Squamous cell carcinomas in African Americans tend to be more aggressive and are associated with a 20-40 percent risk of metastasis (spreading).

While melanoma is uncommon in African Americans, Latinos, and Asians, it is frequently fatal for these populations.

Ninety percent of pediatric melanoma cases occur in patients aged 10-19.
AGING SKIN

- effects often become noticeable by 40’s

**Hair**
- thinner and grayer as melanocytes die and mitosis slows

**Oil glands**
- sebaceous glands atrophy
- skin and hair become drier

**Skin Layers**
- mitosis declines, collagen is lost from dermis
- skin becomes thinner and translucent
- looser and sagging as elastic fibers are lost and dermal papillae smooth out
- fewer blood vessels and those remaining are more fragile
- more bruising, slower healing and rosacea--tiny dilated blood vessels esp. in nose and cheeks
- age spots – accumulation of pigment cells
- loss of immune cells and fibroblasts makes skin more susceptible to infection
thermoregulation is less efficient due to loss of blood vessels and glands
more vulnerable to hypothermia and heatstroke

**photoaging** = an acceleration of skin aging due to overexposure to sun (UV)
accounts for 90% of the changes that people find medically troubling or cosmetically disagreeable