Skin & Membranes

cells → tissues → organs

Membranes

the simplest organs

different from cell membranes

most consist of at least 2 different tissues:
- epithelial
- connective

usually considered part of another organ

kinds of membranes in the body:

1. Mucous
   lines passages that open to exterior of body
   squamous or columnar epithelium on areolar tissue
   protection, secretion, absorption

2. Serous
   lines closed cavities of the body
   simple squamous epithelium on areolar tissue
   secretes serous fluid for lubrication

   thorax = pleura
   abdominal = peritoneum
   heart = pericardium

   parietal vs visceral

3. synovial
   connective tissues only
   no epithelial tissues

   lines joint cavities
   secretes fluid = synovial fluid
   → reduces friction at moveable joints

   also forms fluid filled sacs around joints
   = bursae
   → reduces friction of muscles, tendons and ligaments moving
4. **cutaneous**
   = integumentary system
   = skin
   covers outer surface of body

**Skin (Integumentary System)**
organ or organ system
organ of greatest surface area:
   15-20 sq ft.
very complex:
   per sq inch:
   15 ft blood vessels
   4 yds nerves
   650 sweat glands
   100 oil glands
   1500 sensory receptor cells
   >3 million cells total

**General Functions:**
1. **protection**
   mechanical
   chemical
   bacterial $\rightarrow$ acid mantle
   UV $\rightarrow$ melanin pigment
   desiccation $\rightarrow$ keratin
2. **temperature homeostasis**
   $>$temp $\rightarrow$ sweat glands, flushing
   $<$temp $\rightarrow$ arrector pili, 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
Layers of Skin:

Epidermis

stratified squamous epithelium
upper layers dead, filled with keratin (waxy protein)
lower layers living cells
replaced every 35-45 days
subdivided into 5 identifiable layers:

a. stratum basale
lowermost layer of epidermis
single cell layer thick
composed of several types of cells
keratinocytes → produce keratin a waxy fibrous protein
most cells of epidermis are these
melanocytes → contain pigment (by phagocytosis) = melanin
~1/4th of all cells in all races
pigment helps prevent damage to skin cells
→ black people rarely have skin cancer
Merkel’s cells → touch
only cells that get adequate nutrition and oxygen by diffusion from tissues below
actively dividing cells
bordered below by basement membrane

b. stratum spinosum
several layers thick
less mitosis
flattened, irregular, spinelike projections
has Langerhan’s cells → macrophage-like
[basale + spinosum = stratum germinativum → growing layers]

c. stratum granulosum
very thin; 2-3 cell layers thick
as cells move up from s. basale they die & get flatter and thinner
keratinization begins here
also has Langerhans cells

d. stratum lucidum
thin translucent band
only found in thick areas of epidermis:
soles of feet
palms of hand

e. stratum corneum
thickest of all layers; 3/4th “s the thickness
of epidermis
20-30 cell layers thick
deep cells completely filled with keratin (=horny)
water resistant
main protection against biological and
chemical assault

**Dermis (=hide)**
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
two layers:
  a. **papillary layer**
     mainly areolar connective tissue
     lots of blood vessels
dermal papillae
capillary loops
sensory cells
produce finger prints
  b. **reticular layer**
     mainly dense (fibrous connective tissue)
lots of parallel collagen fibers
lines of cleavage between collagen bundles
   → tension lines
   longitudinal in limbs
circular around trunk
incisions parallel to lines heal quicker
dermal tearing = stretch marks (silvery)

**Subcutaneous Layer**
below skin
mainly adipose tissue
insulation

**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
mainly in stratum basale
freckles & moles = local accumulation of pigments

suntan

carotene
esp in stratum corneum and subcutaneous layers

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 = 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

"**Derivitives of skin**"

during embryonic development 1000’s of small groups of epidermal cells from stratum basale push down into dermis to form hair follicles and glands

**Hair**
covers entire body except palms and soles
humans are born with as many follicles as they will ever have
hairs are among the fastest growing tissues in the body
hormones account for the development of “hairy” regions: eg. head, axillary and pubic areas

not evenly distributed on skin:
? 100,000 scalp
? 30,000 man’s beard

baldness:
genetic
stress or trauma
treated with minoxidil
different kinds and functions
esp in other mammals;
not as much in “naked ape”
vellus = fine hairs
protective hairs: eyelashes, nose, ears
formation similar to epidermis
heavily keratinized
hair color depends on kinds (yellow, rust, brown, and black) and the amount of melanin it contains
consists of:
  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)
g ≥2/follicle

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 (eccrine glands)
~3 Million total on skin
~3000 sweat glands/inch²
most numerous on palms, soles, forehead,
armpits
essentially a tiny coiled tube that opens to skin surface
helps maintain temperature and fluid/electrolyte balance
→ heat → sweat → evaporative cooling

Scent Glands (apocrine glands)
modified sweat glands
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”
scents, stress, pheromones

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

Nails
scale-like modification of the epidermis
 corresponds to hoof or claw of animals
transparent and nearly colorless
nail bed composed of stratum basale

Skin Imbalances & Aging
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
   1. 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**
   - eg. boils and carbuncles
     - inflammation of hair follicle and sebaceous glands
     - esp on dorsal side of neck
   - eg. 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
     - 1\(^{st}\) degree burns
       - skin is inflamed, red
       - surface layer of skin is shed
     - 2\(^{nd}\) degree burns
       - deeper injury
       - blisters form as fluid builds up beneath outer layers of
         epidermis
     - 3\(^{rd}\) 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
extend 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

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 cant 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
   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

F. Aging Skin
   wrinkles – loses elasticity
   age spots – accumulation of pigment cells
   thinning and graying of hair – loss of pigment
   drying - skin glands less active
   black & blue marks – greater fragility of capillaries

Clinical Terms:

Necrosis – cellular or tissue death, gangrene

Biopsy – tissue analysis