Integumentary System – the skin and its derivative appendages; maintains boundaries

Skin Layers:

Epidermis (most superficial)

Dermis (deepest)

Hypodermis (deeper still; not technically part of skin; mostly adipose; stores fat, anchors, cushions, and insulates)

The Epidermis – a keratinized, stratified squamous epithelium with 4 distinct cell types and 4-5 layers (p.150-152)

Cells of the Epidermis

Keratinocytes (make protective *keratin*)

Melanocytes (synthesize *melanin* pigment)

Epidermal Dendritic (*Langerhans) Cells* (star-shaped, phagocytic immunoactivators)

Tactile (Merkel) Cells (attach to nerves to form sensory *Merkel discs*)

Layers of the Epidermis

Stratum Basale (basal layer; deepest; a row of keratinocytes and 10-25% melanocytes)

Stratum Spinosum (spiny layer; pre-keratin filaments; spiky desmosomes)

Stratum Granulosum (cells flatten & form *keratohyaline granules* & *lamellated granules)*

Stratum Lucidum (clear layer; only visible in thick skin)

Stratum Corneum (horny layer; most superficial; 20-30 layers of dead, keratinized cells)

Waterproof due to glycolipids from lamellated granules

Abrasion-resistant due to keratinization from keratohyaline granules

The Dermis – strong, flexible connective tissue underlying the epidermis (p.152-155)

Characteristics of the Dermis

Your living "hide"

Highly innervated, vascularized, and lymphaticized

Typical connective tissue proper

Houses derivative appendages

2 Layers: *papillary layer* and *reticularlayer*

Papillary Layer of the Dermis

Mostly areolar tissue

Phagocytes wander freely

Nerve endings and touch receptors

Dermal papillae ("nipples") extend upwards

Dermal/epidermal ridges = friction ridges = fingerprints

Reticular Layer of the Dermis

Mostly dense, fibrous connective tissue

Underlying *cutaneous plexus*

Adipose pockets

Mostly parallel bundles of collagen (form *tension lines*, pic on p.154)

Skin color – differential absorption and reflection of light caused by three pigments: *melanin*, *carotene*, and *hemoglobin*

The Pigment Melanin, manufactured in the skin's melanocytes
a polymer of tyrosine

ranges from yellow→tan→reddish-brown→black

more sun = more melanin production and retention = darker skin
(immediately *and* genetically)

The Pigment Carotene, found in carrots & co.

accumulates in fat of hypodermis and in stratum corneum

yellow-orange

seen in palmar and plantar regions

The Pigment Hemoglobin, found in red blood cells

causes pinkish hue of skin low in melanin

causes pinkish hue when skin is cold, hot, or excited

Apparent hemostatic imbalances of the skin

- Cause: Overexposure to sun overwhelms melanin's protective ability
  Effect seen: *sunburn, rash, peeling, skin cancer*
- Cause: Embarrasment, fever, hypertension, inflammation, allergy
  Effect seen: *Redness (erythema)*
- Cause: fear, anger, stress, anemia, low blood pressure
  Effect seen: *Pallor, blanching, paling*
- Cause: liver disorder causes; yellow bile builds up in bloodstream
  Effect seen: *Jaundice (yellow cast)*
- Cause: Addison's disease or pituitary gland tumor(s)
  Effect seen: *Bronzing*
- Cause: Blood escapes from circulation and is trapped, clotted, under the skin
  Effect seen: *Hematomas (bruising, black-and-blueness)*

Appendages of the Skin: nails, sweat glands, sebaceous glands, hair follicles, and hair, all formed from *epithelial buds*

Sudoriferous (Sweat) Glands – secretory cells associated w/ nerve-activated myoepithelial cells

Eccrine Sweat Glands: your typical sweat glands w/ Simple tubular structure

Found everywhere, esp. . .

Sweat: H20, NaCl, wastes, pH 4-6, influenced by genetics

Sympathetic autonomic regulation

Heat-induced or stress-induced

Apocrine Sweat Glands – function uncertain; may be vestigial sexual scent glands

Ceruminous glands (make "cerumen," aka earwax)

Mammary glands (detailed in Ch. 27)

Sebaceous (Oil) Glands: simple branched alveolar structure; produce oil (sebum)

Softener

Bactericide

Holocrine secretion

Hairs and Hair follicles

Hair structure – root and shaft portions, both composed of. . .

Central medulla

Cortex

Outer cuticle

Hair color

Hair types: *Vellus* hairs and Terminal hairs

Hair follicles

Inner epithelial root sheeth

Hair bulb

Highly vascular and innervated

Arrector pili muscles

Hair growth

Life span of hair= hair length

Longer follicular resting periods = thinner hair (*alopecia)*

Functions of the Integumentary System: protection, body temp. regulation, sensation, metabolism, storage of blood, excretion

Protection: maintaining chemical, physical, and biological boundaries

Chemical protection: the *acid mantle, defensins,* and *cathelicidins*

Physical/Mechanical protection: continuity and hardness

Biological protection: dendritic epidermal cells, macrophages, melanin, DNA

Body Temp. regulation: *insensible* and *sensible* perspiration, dermal blood vessel constriction

Cutaneous sensation: Meissner's corpuscles, pacinian corpuscles, tactile discs, hair follicles

Metabolism: Vitamin D synthesis, keratinocytes convert chemicals

Storage of blood: holds 5% of total blood volume, can release it when needed elsewhere

Excretion through sweat: some ammonia, mostly H_20 and NaCl

Homeostatic Imbalances of the Skin: skin cancer, burns, and conditions

Skin Cancer: strikes 1 in 5 Americans

- Most are benign (phew)
- More UV exposure = higher risk
- Fas proteins cause damaged cells to suicide
- A "healthy tan?"
- New lotions w/ liposomes can help repair DNA
- 3 types of Skin Cancer: *basal cell carcinoma, squamous cell carcinoma,* and *melanoma*

Basal Cell Carcinoma:

Least malignant, most common (80%)
Stratum basale cells invade dermis and hypodermis
forms shiny, dome-shaped nodules w/ pearly, beaded edges
slow-growing, easily noticed, easily removed

Squamous Cell Carcinoma:

Second most common, often on head and hands
Arises from keratinocytes of stratum spinosum
Forms scaly reddened *papule*
Grows and *metastasizes* rapidly; easily removed if noticed early

Melanoma:

Cancer of the melanocytes
Least common, most dangerous
Appear spontaneously, 1/3 from existing moles
Forms a spreading brown or black patch
Metastasizes rapidly to lymph and blood vessels
Early detection for survival: **A**
B
C
D
(E)

Burns – tissue damage from intense heat, radiation, or corrosive chemicals causing protein denaturation and cell death

Threats from Burns

Fluid loss (rule of nines)

Caloric deficiency

Sepsis after 24 hrs

Burns: First, Second, and Third Degree

First Degree Burns: involve epidermis only

<u>localized</u> pain, redness, and swelling

heals naturally in 2-3 days (ex: sunburn)

Second Degree Burns, aka ***partial thickness burns:*** involve epidermis *and* upper dermis

blistering occurs

heals in 3-4 weeks if infection is prevented

critical if over more than 25% of body

Third Degree Burns, aka ***full thickness burns:*** involve all layers of skin

critical if over 10% of body, or if over face, hands, or feet

appears gray-white, cherry red, or blackened

temporary covering and grafting usually necessary

Autografts

Synthetic skin + Cultured epidermis

Skin conditions (p.168)

Dermatology: the study and treatment of skin conditions

Albinism

Boils and Carbuncles

Cold sores (fever blisters)

Contact dermatititis

Decubitis ulcers

Eczema

Epidermolysis bullosa (EB)

Impetigo

Porphyria

Psoriasis

Rosacea

Vitilago

Developmental Aspects of the Integument

Embryonic Development

Epidermis develops from ectoderm

Dermis and hypodermis develop from mesoderm

Fetal Development

Downy *lanugo coat*

Waxy *vernix caseosa*

White *milia*

Childhood

Skin thickens, fat accumulates

Sweat glands activate

Adolescence

Sebaceous glands activate

More hair follicles activate

Adulthood

Acne subsides, skin reaches “optimal” appearance

Old Age

Mitosis slows, skin thins

subcutaneous fat layer diminishes

sebaceous glands and hair follicles deactivate

melanin production slows