

# INTRODUCTION

## Concept

1. Body's covering
  - a. Continuous with mucous membranes of all openings
    - \_ Nostrils
    - \_ Mouth
    - \_ Anus
    - \_ Urethra
    - \_ Vagina
  - b. Within depressions
    - \_ External ear canals
    - \_ Umbilicus
2. Organ vs. System
  - a. Integument as an organ
    - \_ Outdated concept
    - \_ Reasons for concept
      - flat, continuous over body
      - layered, as many organs appear
  - b. Integumentary system
    - \_ Current concept
    - \_ Reasons for concept
      - much more than just a covering
      - parts perform as separate organs
      - functions have systemic implications

## Functions

[ *Many same as epithelial* ]

## 1. Protection

- a. Mechanical -- against trauma
- b. Chemical
- c. Osmotic
- d. Microbial
- e. Ultraviolet radiation

## 2. Mobility

- \_ Permits varying degrees of freedom of movement
- \_ Ex. highly modified over joints

## 3. Sensations

- \_ Its position is ideal for awareness
- \_ Sensations from various receptors (sense organs)
  - a. Pain
  - b. Touch
  - c. Pressure
  - d. Thermal

## 4. Temperature regulation

- a. Sweating
  - \_ Eccrine sudoriferous glands
  - \_ Wet skin carries away more heat
- b. Extra blood vessels
  - \_ Papillary layer
  - \_ Blood optionally circulated through
    - closer to surface radiates more heat

- deeper retains heat

- \_ Controlled by nervous system

c. Insulation from subcutaneous adipose

## 5. Blood pressure regulation

- \_ Extra blood vessels -- different from temperature set

- \_ Blood optionally circulated through

- \_ Through more vessels -- pressure dissipated

- \_ Through fewer vessels -- pressure enhanced

- \_ Controlled by nervous system

## 6. Excretion

a. Sweat

- \_ Water

- utilized for cooling

- waste metabolic substance, however

- \_ Dissolved substances

- in excess (Na & Cl ions)

- toxic (ammonia)

b. Sebum

- \_ Sebaceous gland secretion

- \_ Ingredients are wastes, however

c. Heat -- from temperature regulation

## 7. Synthesis

- \_ Vitamin D

- \_ Within stratum basale & spinosum

- \_ Converted cholesterol derivative + UV light
- \_ Benefit to entire body

8. Storage -- fat within adipocytes

9. Scent -- apocrine sudoriferous glands

## Structural Plan

### 1. General

- \_ Basically layered [ *details later* ]
- \_ Organs scattered within

### 2. Surface

#### a. Pitted

- \_ Ducts
- \_ Hair follicle openings

#### b. Furrowed

- \_ Intersecting lines
- \_ Geometric patterns -- on smoother surfaces
- \_ Cobblestone look
  - over joints
  - analogous to transitional epithelium

#### c. Ridges/grooves

- \_ Palms and soles
- \_ Unique -- genetically determined
- \_ Use & damage lines appear after birth
- \_ Functions
  - enhance grip

-- enhance tactile sensitivity

### 3. Thickness

- a. Thinnest -- 1.5 - 2 mm (joints)
- b. Thickest -- about 4 mm (dorsal cervical)
- c. Thicker in men than women

## EPI DERMIS

### General

#### 1. Relative thickness

- \_ Always thinner than dermis
- \_ Range -- 0.08 - 0.5 mm

#### 2. Keratinization

- \_ Unique (excepting hard palate)
- \_ Only fully functional dead cells in body
- \_ Keratin
  - \_ Fibrous protein
  - \_ Very tough, flexible, water resistant

3. Receptors -- for light touch (e.g. free nerve endings)

### Layers / Cell Replacement

#### 1. Replacement

- a. Reason
  - \_ Mechanical
  - \_ Upper keratinized layers worn away at high rate

## b. Basic scheme

- \_ Basal cells multiply
- \_ Daughter cells ascend
- \_ Synthesis of keratin occurs
- \_ Reach stratum corneum
  - about 2 weeks
  - keratin synthesis completed
- \_ Reach surface in about 2 weeks

## c. Variability

- \_ Faster with excess wear
- \_ Under one week from base to free surface

## 2. Layers

## a. Stratum basale

- \_ Mitotic cell division
- \_ Pigment cells -- melanocytes [ *details later* ]
- \_ Nourished by underlying dermis

## b. Stratum spinosum

- \_ Intercellular cytoplasmic strands -- gives name
- \_ Variable number of layers
- \_ Mitotic cell division if required -- excess wear

## c. Stratum granulosum

- \_ Indistinct layer in thin skin
- \_ Granules of keratohyalin -- keratin precursor

## d. Stratum lucidum

- \_ Absent in thin skin

- \_ Contains eleidin -- keratin precursor

e. Stratum corneum

- \_ Only several layers in thinnest skin
- \_ 50 or more layers in palms & soles

## DERMIS

### General

#### 1. Overall concept

a. Thickness compared with epidermis

- \_ Generally 20 times thicker
- \_ Palms & soles -- 8 times thicker

b. Connective tissue

- \_ Dense irregularly arranged collagenous
- \_ Tangled, intricate net-like

#### 2. Importance

a. Responsible for most variations

- \_ Thickness
- \_ Toughness
- \_ Flexibility

b. Controls epidermis

- \_ Nourishment
- \_ Physical support

### Layers

#### 1. Papillary

- a. Less dense than reticular
- b. Extra blood vessels
  - \_ Nourish epidermis
  - \_ Body temperature regulation
- c. Serves as basement membrane for epidermis
- d. Papillae
  - \_ 65,000 per square inch
  - \_ Largest -- palms, soles, lips, nipples, penis & clitoris
  - \_ Smallest & least numerous -- face & trunk
  - \_ Provide surface area to aid interlocking with epidermis
  - \_ Cause friction ridges
    - epidermis passively follows pattern
    - double row under each ridge
- e. Receptors -- e.g. Meissner's corpuscle for touch

## 2. Reticular

- a. Much thicker, coarser & denser than papillary
- b. Structure
  - \_ Collagenous bundles -- parallel surface
  - \_ Elastic fibers intermingled
  - \_ Less vascular than papillary
  - \_ Cells -- mostly fibrocytes & macrophages (fewer)
- c. Contains numerous organs
  - \_ Hairs
  - \_ Glands
  - \_ Receptors -- e.g. pressure

# SUBCUTANEOUS

## A. Adipose

### 1. Functions

- \_ Insulation
- \_ Protection -- padding

### 2. Variable distribution

- \_ Men -- more neck, upper arms, lower back, buttocks
- \_ Women -- more breasts, buttocks, hips, thighs
- \_ Anyone -- abdominal

## B. Areolar

- \_ Also termed superficial fascia
- \_ More beneath adipose -- intermingled as well
- \_ Provides flexibility over underlying muscles

# PI GMENTATI ON

## General

1. Melani n
  - a. Functi on
    - \_ Protecti on from ul travi ol et radi ati on
    - \_ Col or not a functi on; j ust a consequence of pigm-  
ents
  - b. Structure
    - \_ Ami no aci d deri vati ve
    - \_ Vari es from yell ow-brown to nearly black
  - c. Locati ons
    - \_ Epi dermi s
    - \_ Dermi s -- sometimes
    - \_ Adrenal medul la
    - \_ Eye -- several locati ons (e.g. retina, iris)
2. Carotenes
  - a. Functi on -- ? -- defi ni tel y no UV protecti on
  - b. Li pi d-rel ated
  - c. Most common orange-yell ow
3. Hemogl obi n
  - a. Functi on -- oxygen transport in red blood cells
  - b. Ski n col or rol e
    - \_ Shows through to vari able extent
    - \_ Depends upon other pigment types and amounts

# Formation & Distribution

## 1. Formation

- \_ Within melanocytes (-blasts)
- \_ Between cells of stratum basale & spinosum (less often)
- \_ Synthesize melanin
  - \_ Always occurring at a basic level
  - \_ Accelerated by increased UV exposure

## 2. Distribution

- \_ Dendrites project from melanocytes
- \_ Melanin injected into surrounding epidermal cells
- \_ Melanin surrounds nucleus -- absorbs UV energy

## 3. Variations

### a. Melanocytes

- \_ Number fairly constant in everyone
- \_ More or less basic activity
- \_ More or less capable with more UV exposure
- \_ Both amount & depth of distribution vary
- \_ Albinism
  - no melanin
  - pinkish skin from hemoglobin
  - blue eyes

b. Freckles -- uneven distribution/activity of melanocytes

### c. Trichosiderin

- \_ Orange-red carotene
- \_ Only in skin of "red headed" people

# HAI R

## Concept

- \_ Considered to be an organ
- \_ Function -- protection
- \_ Epidermal origin
  - \_ Mostly located within dermis -- sometimes into hypodermis
  - \_ Homology of parts with epidermal strata

## Formation

1. Origin -- from stratum basale
2. Growth & development
  - \_ Column of new cells
  - \_ Grow down, invading dermis
  - \_ Keratinization process
  - \_ Development towards hollow center of column
  - \_ Keratinized cells form hair shaft
    - \_ Shaft pushes up and out
    - \_ Oldest part of shaft at distal end
    - \_ Grows about 0.33 mm per day
  - \_ Follicle wall layers equivalent to living epidermal strata
  - \_ Accessory structures
    - \_ Sebaceous glands [ *details later* ]
    - \_ Arrector pili -- smooth muscle; no use

## Changes

### 1. Resting follicle

- \_ Follicle ceases growing
- \_ Bulb shrivels -- it provided nourishment

### 2. Reactivation

- \_ Germinal follicle layer begins new growth
- \_ New bulb develops -- outgrowth of old bulb
- \_ New root and shaft develops
- \_ Old follicle pushed out
- \_ Cycle is several months to several years long

### 3. Age changes

- \_ Reactivation ceases for some follicles
- \_ Hair amount decreases

## Variations

### 1. Color

- a. Amount & distribution of melanin in shaft
  - \_ Reflects light variably
  - \_ Different from skin color
  - \_ Gray / white -- air spaces
- b. Trichosiderin -- produces red hair

### 2. Texture

- a. Curly -- follicle & shaft very flattened (ribbon-like)
- b. Wavy -- follicle & shaft ovoid

c. Straight -- follicle and shaft cylindrical

### 3. Sex

- \_ Both sexes -- same number & distribution
- \_ Texture & size vary in males & females

## NAI LS

### A. Functions

1. Protection
2. Grasping

### B. Structure

#### 1. General

- \_ Epidermal derivative
- \_ More solid stratum corneum -- extracellular keratin
- \_ Growth rate
  - about 1 mm / week
  - toenails much slower

#### 2. Distinctive parts

##### a. Nail root

- proximal end, unexposed
- active growth area

##### b. Nail fold

- covers root
- eponychium (cuticle) its stratum corneum

##### c. Body

beneath

- exposed part
- hyponychium (quick) is skin attached beneath
- Lunule (white) is more opaque / less vascular

d. Nail bed

- beneath nail
- large dermal ridges; basale & spinosum follow
- growing nail slides over this, pushed from root

## GLANDS

### General -- *Entire Body*

1. Concept

- \_ Organ [usually, but sometimes individual cells]
- \_ Produces secretion and/or excretion

2. Secretion vs. Excretion

a. Secretion

- \_ Synthesis & release of useful product
- [ *primary consideration at this time* ]

- b. Excretion -- separation & elimination of metabolic waste products from body

3. Formation

- \_ Epithelial origin -- begin in embryo
- \_ Scheme
  - \_ Localized extra cell division
  - \_ Cells grow in column downward into connective

tissue

- \_ Develops lumen
- \_ Distal portion becomes primary secretory area
- \_ Upper portion varies [ *details later* ]

## Classification (Types) -- *Entire Body*

### 1. Site of discharge

- a. Exocrine -- upper portion retained as duct
- b. Endocrine
  - \_ Upper portion degenerates
  - \_ Ductless -- hormone secretion into blood

### 2. Size

- a. Unicellular -- goblet cell
- b. Organs
  - \_ Microscopic -- e.g. gastric
  - \_ Macroscopic -- e.g. pancreas
    - typically subdivided into similar lobes
    - largest further subdivided into lobules

### 3. Structure

- a. Basic shapes
  - \_ Tubular
  - \_ Saccular (alveolar)
  - \_ Acinar
- b. Complexity
  1. Simple -- 1 duct
    - single type has only one tube (e.g.)
    - branched has several tubes (e.g.)
  2. Compound -- >1 duct

- one main duct
- >one main duct

#### 4. Kind of secretion

- a. Mucous -- e.g. goblet or esophageal
- b. Serous
  - \_ Watery, with dissolved substances
  - \_ e.g. pancreas
- c. Sero-mucous
  - \_ Both, from different gland regions
  - \_ e.g. salivary
- d. Lipid -- e.g. sebaceous
- e. Cellular
  - \_ Live -- sperm or ova
  - \_ Dead -- sebaceous

#### 5. Method of secretion [ *examples later* ]

- a. Merocrine (eccrine)
  - \_ Specific type of exocytosis (reverse pinocytosis)
  - \_ Secretion within vesicles
  - \_ Vesicles fuse with inner cell membrane
  - \_ Released by membrane rupture
  - \_ Vesicle membrane simultaneously closes opening
- b. Apocrine
  - \_ Secretion accumulates at free end of cell
  - \_ Secretion-containing free end pinches off
  - \_ Cell regenerates lost portion

- c. Holocrine
  - \_ Secretion accumulates within entire cell
  - \_ Cell dies and disintegrates

## Integumentary Glands

### 1. Sebaceous (oil)

#### a. Structure

- \_ Associated with hairs -- simple, branched alveolar
- \_ Independent -- compound alveolar

#### b. Functions

- \_ Soften stratum corneum surface and hair shafts
- \_ Bacteriostatic

#### c. Secretion -- sebum (oily, but not true oil)

- \_ Fatty acids -- various
- \_ Glycerides -- di- and mono-
- \_ Cholesterol
- \_ Waxes -- various
- \_ Cellular debris -- due to holocrine method

#### d. Variations

- \_ Most numerous & largest -- face, back, chest, nipples
- \_ Meibomian glands -- eyelashes
- \_ Acne -- blocked, inflamed ducts from overactivity

### 2. Sudoriferous ("sweat")

## a. "Apocrine"

1. Misnamed -- really secrete by merocrine method
2. Structure
  - simple, branched tubular
  - empty into hair follicles
3. Do not produce true sweat
  - slight secretion, sticky
  - mostly proteins
4. Scent primary (only ?) function
  - secretion mixes with sweat
  - bacterial breakdown products cause aroma
5. Restricted locations
  - axillae
  - areolae
  - umbilicus
  - genital
  - anal
  - external ear (ceruminous glands, ear wax)

## b. Eccrine -- true sweat glands

1. Structure -- single coiled tube
2. Function
  - body temperature regulation
  - excretion
3. Secretion
  - water (about 99%)

- excess ions (Na, K, Mg, Cl, HCO<sub>3</sub>, etc.)
- urea (much, from amino acid metabolism)
- ammonia (some, from amino acid metabolism)
- lactic acid (much, from muscle metabolism)
- excess amino acids (some)
- excess proteins (slight)
- excess lipids (slight)

#### 4. Variations

- 200-300 / cm<sup>2</sup>
- more in hairless skin
- insensible sweat always occurs (300-700 ml /day)
- in high temperatures/activity (10-14 L/day)

### 3. Mammary

#### a. Structure

- \_ Very complicated compound alveolar duct
- \_ 15-20 lobes (per breast) -- each with lactiferous
- \_ Each lobe subdivided into lobules
- \_ Reduced or absent until pregnancy

#### b. Function -- infant nutrition

#### c. Secretion -- apocrine method

- \_ Water (88%)

- \_ Protei ns -- casei ns & l actal bumi ns
- \_ Lactose -- di sacchari de (glucose + galactose)
- \_ Li pi ds -- fats, phosphol i pi ds & chol esterol
- \_ Vi tami ns -- complete, wi th vari abl e amounts
- \_ I ons -- Ca, P, Na, Cl , K, Fe, I , Zn, Mg, S, &
- \_ Enzymes -- si gni fi cance-?
- \_ Anti bodi es
- \_ Bi fi dus factors -- promote normal i ntesti nal

many trace

bacteri a