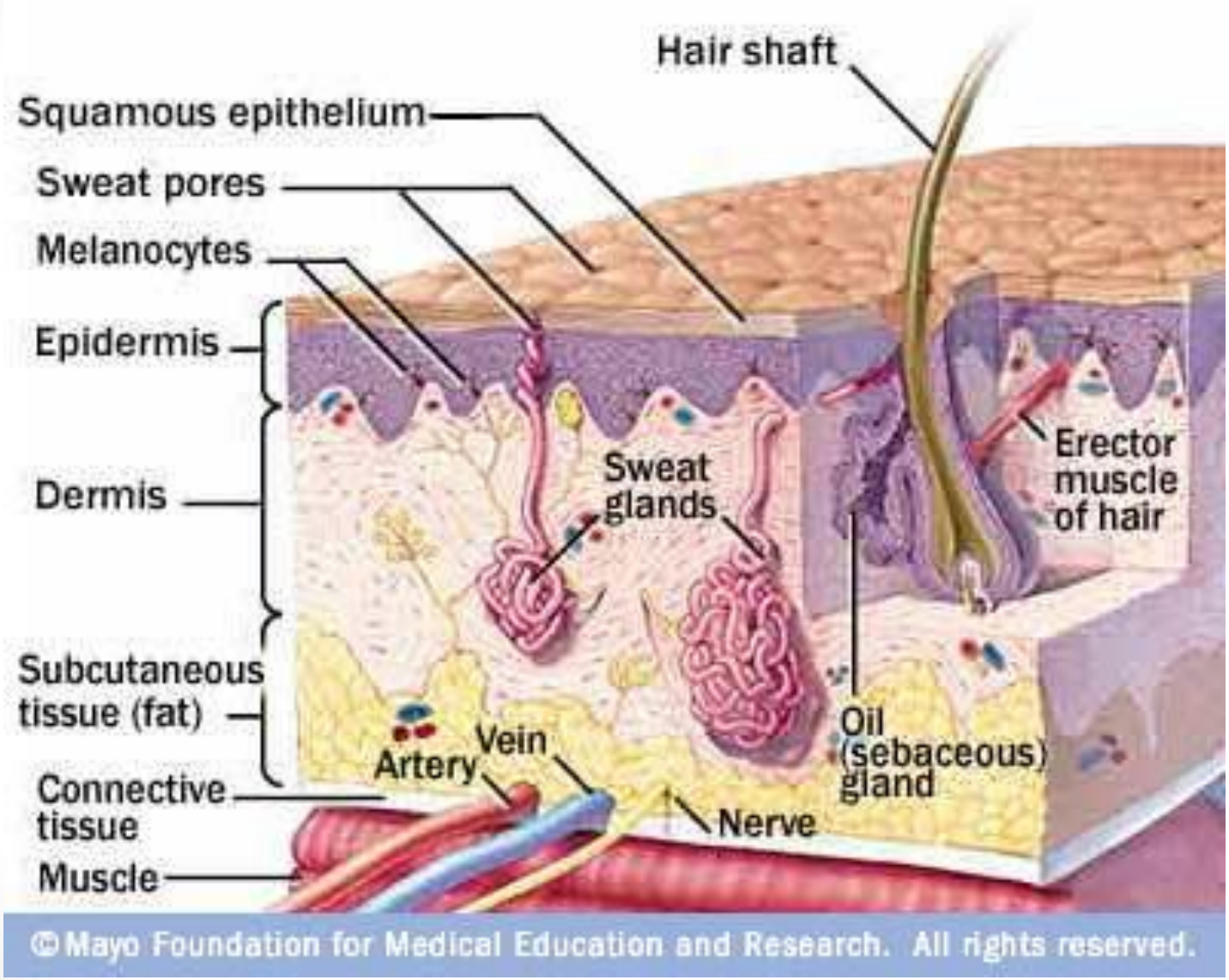
Integumentary System

Chapter 6

4 Functions

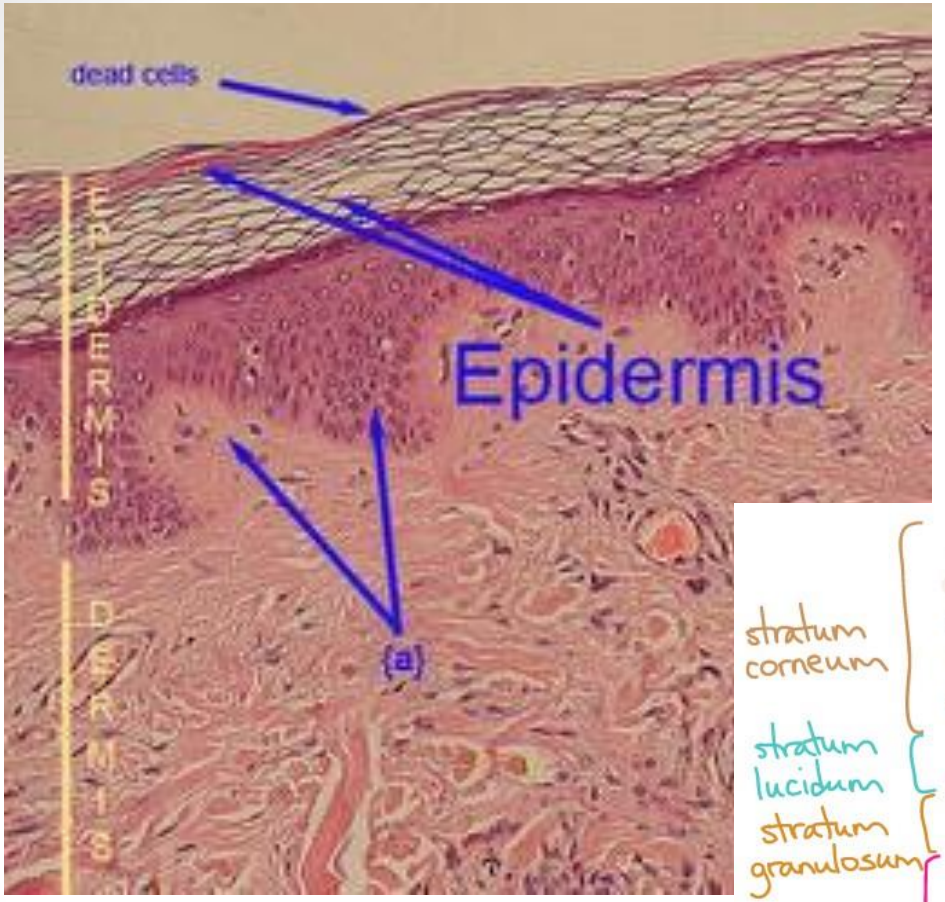
- Protection
- Heat loss and retention
- Removal of urea and uric acid (nitrogen waste)
- Production of Vitamin D

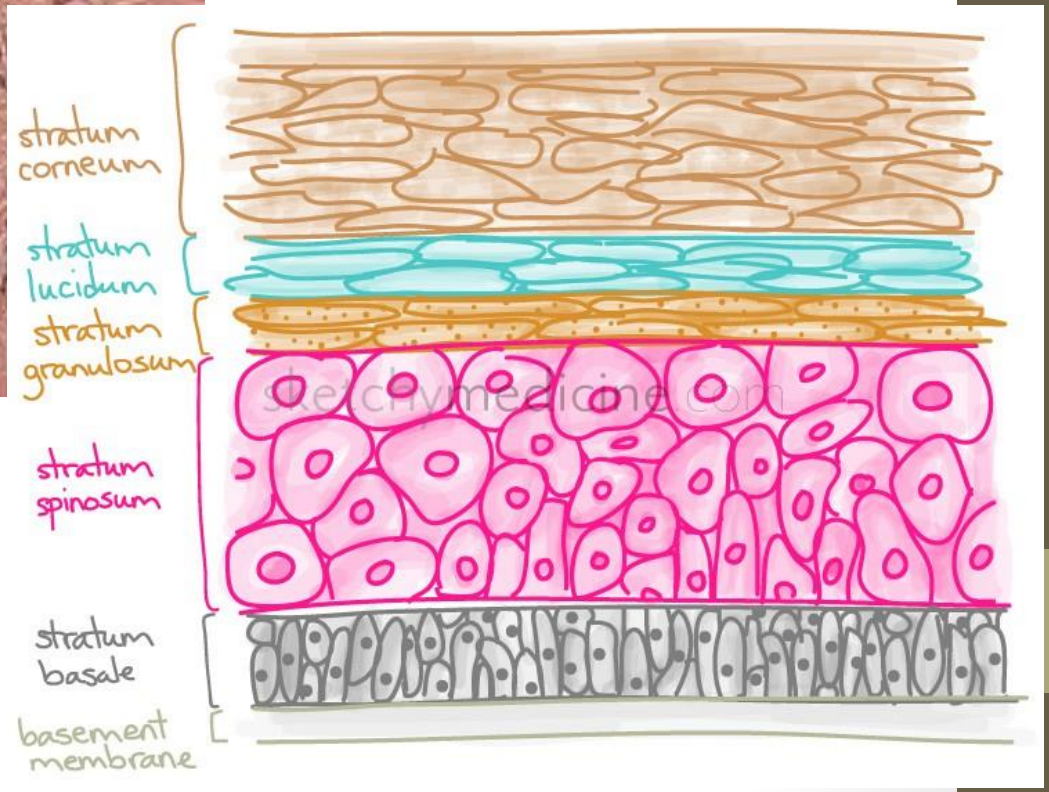

Hair shaft
Squamous epithelium
Sweat pores
Melanocytes
Epidermis
Dermis
Subcutaneous tissue (fat)
Connective tissue
Muscle
Sweat glands
Erector muscle of hair
Oil (sebaceous) gland
Artery
Vein
Nerve
©Mayo Foundation for Medical Education and Research. All rights reserved.

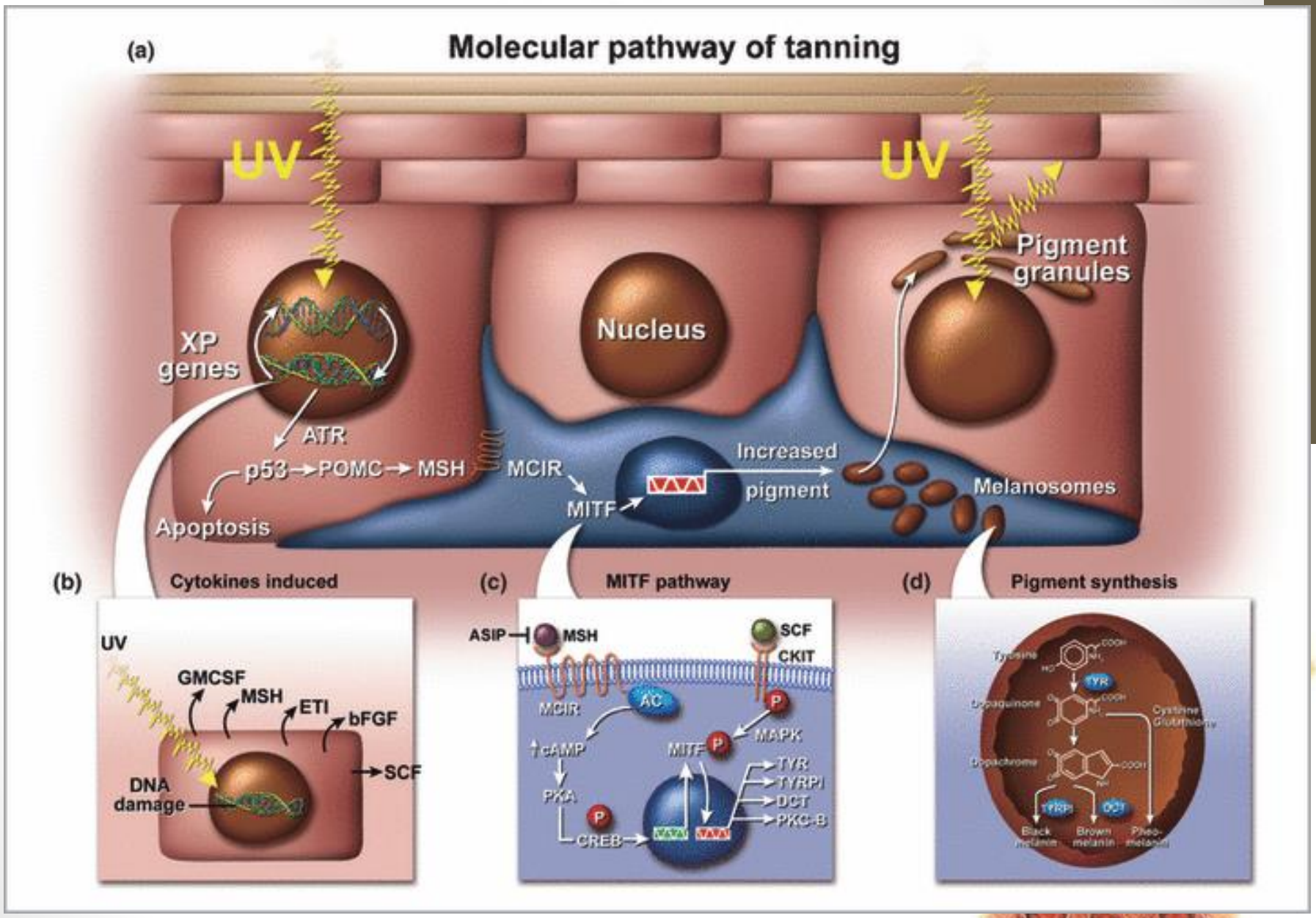
Epidermis

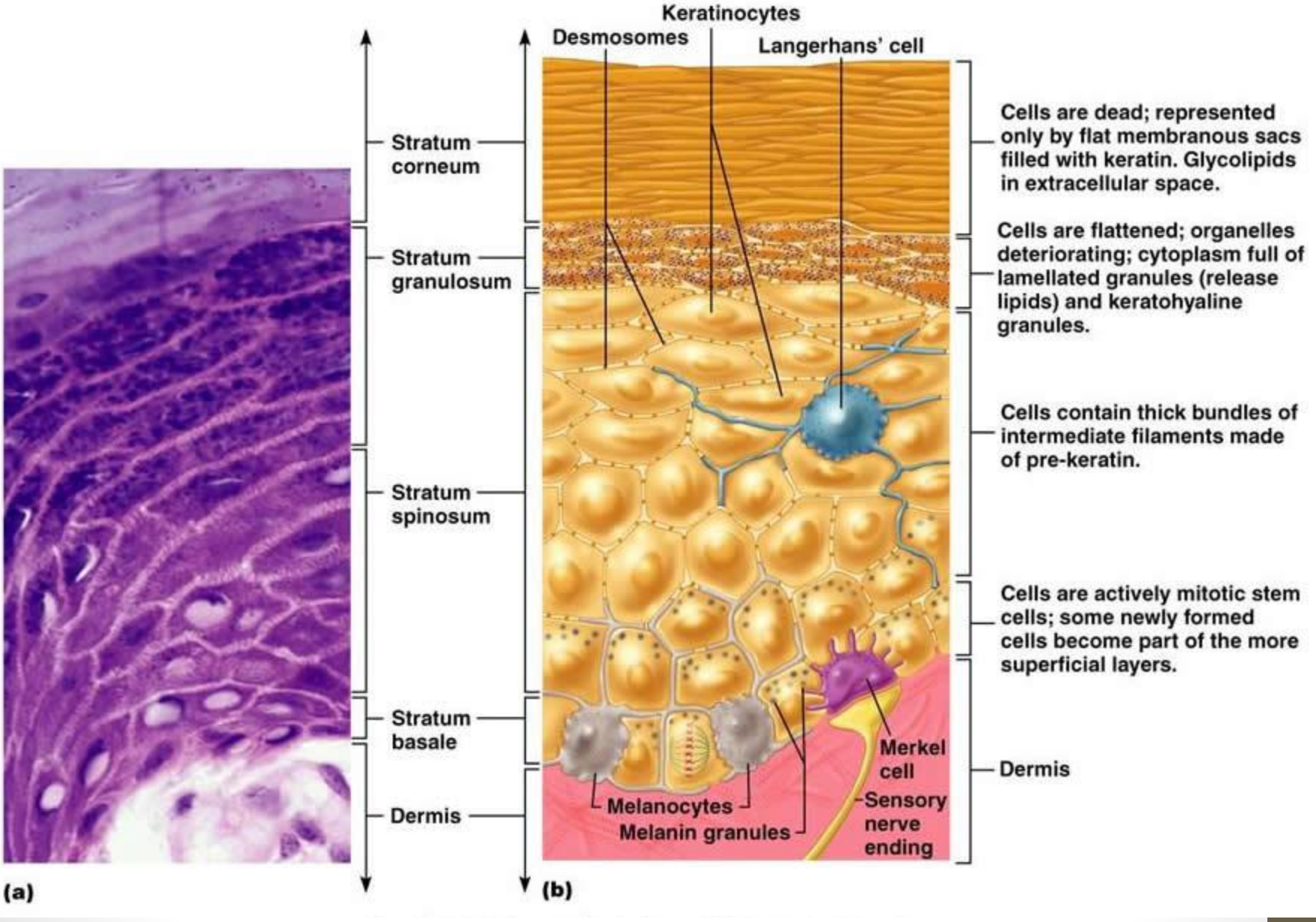
a. 5 layers: Stratum corneum, lucidum (only in hairless places like palms and soles of feet), granulosum, spinosum, and basale

b. Keratinization = producing keratin to make a hard and tough protective layer
c. Melanin = black/brown pigment
d. Melanocytes = cells that produce melanin


dead cells
Epidermis
EPIDERMIS
DERMIS
(a)


stratum corneum
stratum lucidum
stratum granulosum
stratum spinosum
stratum basale
basement membrane
sketchymedicine.com


(a)
Molecular pathway of tanning
UV
UV
Pigment granules
XP genes
Nucleus
ATR
p53 → POMC → MSH
MCIR
MITF
Increased pigment
Melanosomes
Apoptosis
(b)
Cytokines induced
UV
GMCSF
MSH
ETI
bFGF
SCF
DNA damage
(c)
MITF pathway
ASIP
MSH
SCF
CKIT
MCIR
AC
P
MAPK
↑cAMP
MITF
P
TYR
TYRP1
DCT
PKC-β
PKA
P
CREB
(d)
Pigment synthesis
Tyrosine
TYR
Dopaquinone
Cysteine Glutathione
Dopachrome
TYRP1
DCT
Black melanin
Brown melanin
Pheo-melanin

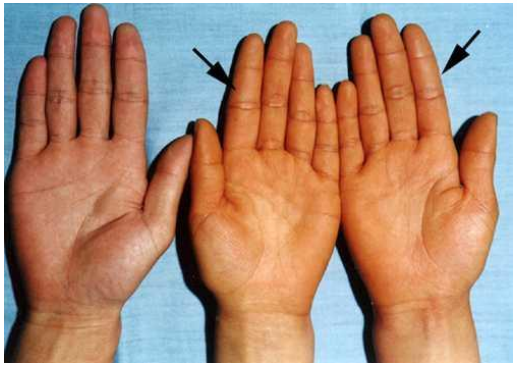

Keratinocytes
Desmosomes
Langerhans' cell
Stratum corneum
Stratum granulosum
Stratum spinosum
Stratum basale
Dermis
Cells are dead; represented only by flat membranous sacs filled with keratin. Glycolipids in extracellular space.
Cells are flattened; organelles deteriorating; cytoplasm full of lamellated granules (release lipids) and keratohyaline granules.
Cells contain thick bundles of intermediate filaments made of pre-keratin.
Cells are actively mitotic stem cells; some newly formed cells become part of the more superficial layers.
Dermis
Merkel cell
Sensory nerve ending
Melanocytes
Melanin granules
(a)
(b)

Skin Colors

- Red – Erythema: embarrassment, inflammation, increased blood flow to surface

- Yellow – Jaundice: when bile pigments get absorbed in blood

- Orange – increased amount of the pigment carotene
- Blue – Cyanosis: bruise, decrease in oxygen
- White – Pallor; decrease in blood pressure, fear, sickness, decrease in blood flow



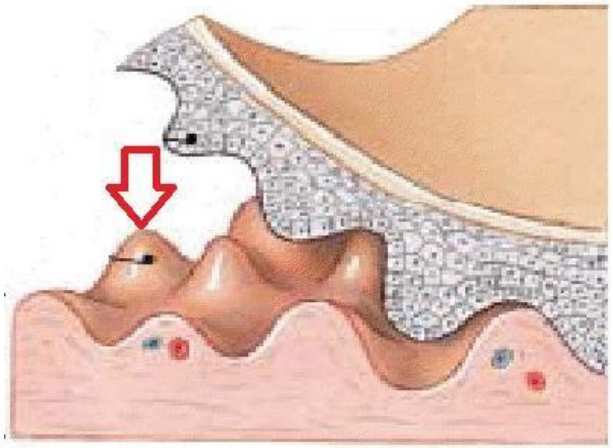
Dermis

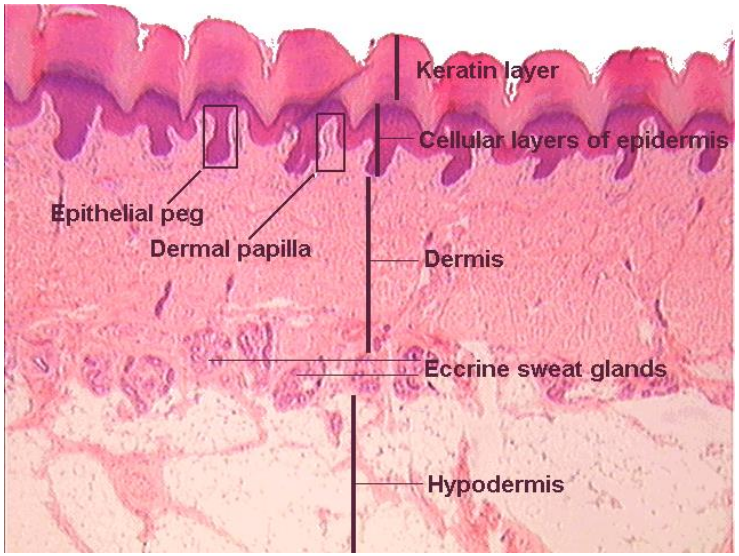
a. 2 layers

   i. Papillary: upper layer – dermal papillae, pain receptors, touch receptors

   ii. Reticular: lower layer – blood vessels, sweat glands – eccrine and apocrine, sebaceous gland, deep pressure receptor

- Dermal papillae: fingerlike projections into the epidermis to supply nutrients → defined ridges create fingerprints





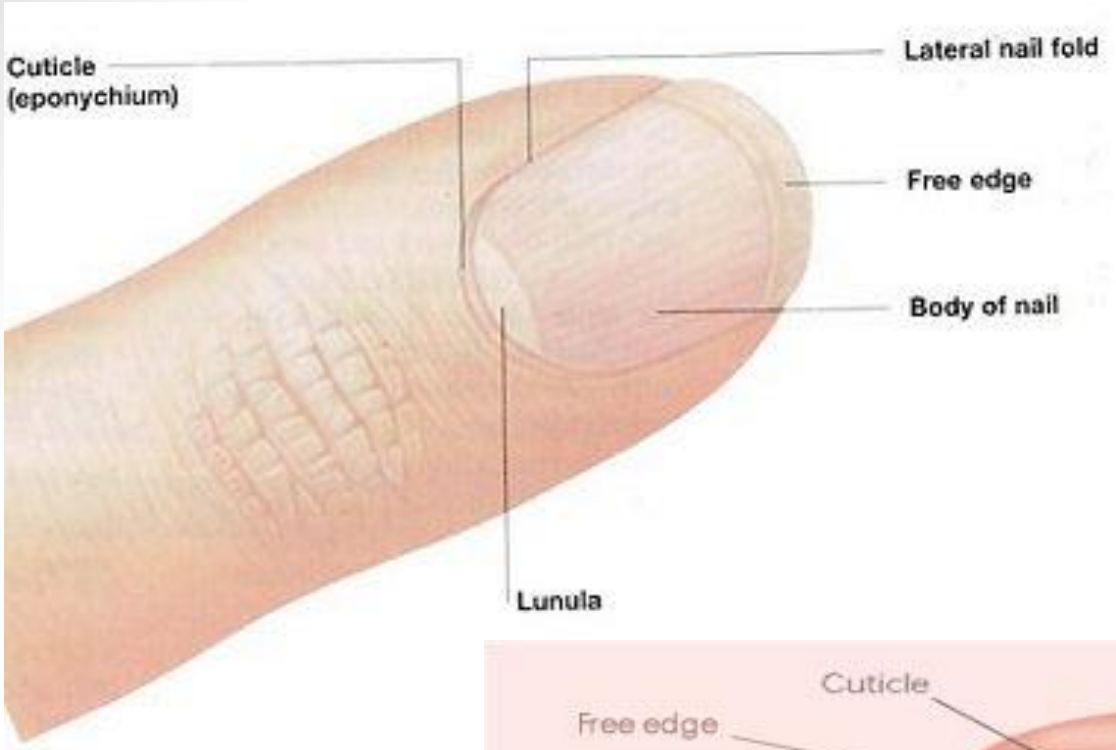
Subcutaneous / Hypodermis

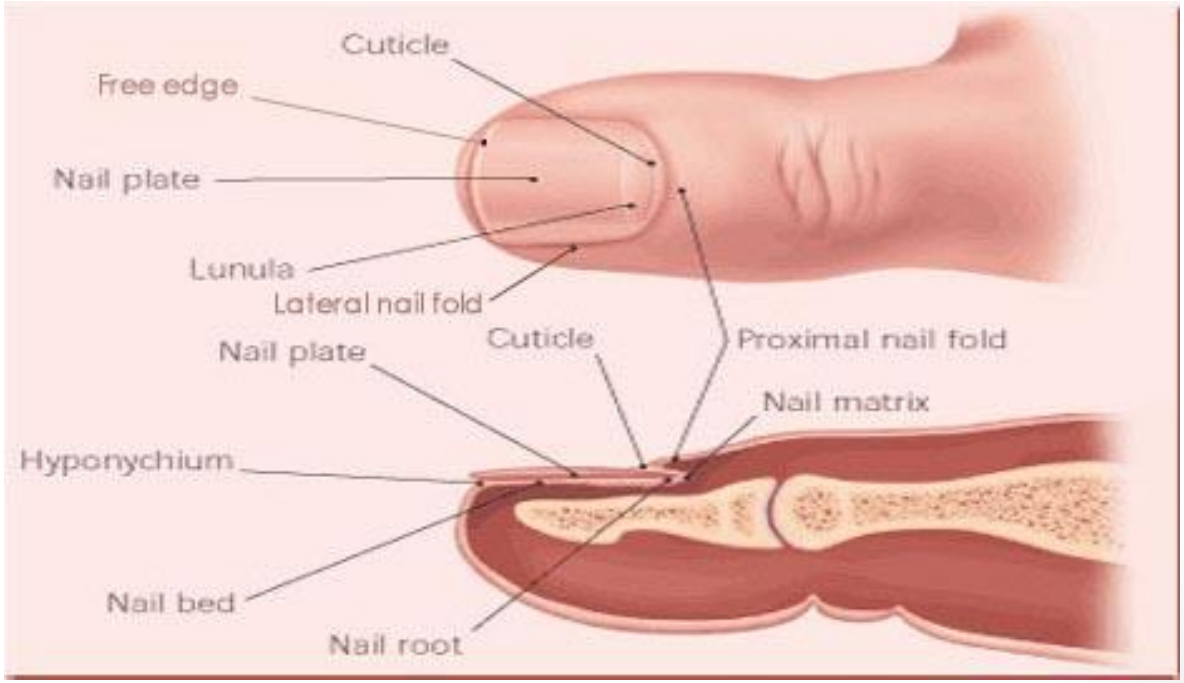
- Structures: blood vessels and adipose tissue (fat)

- Skin's toughness:
  - Epidermis = keratin
  - Dermis = collagen and elastic fibers

Accessory Structures

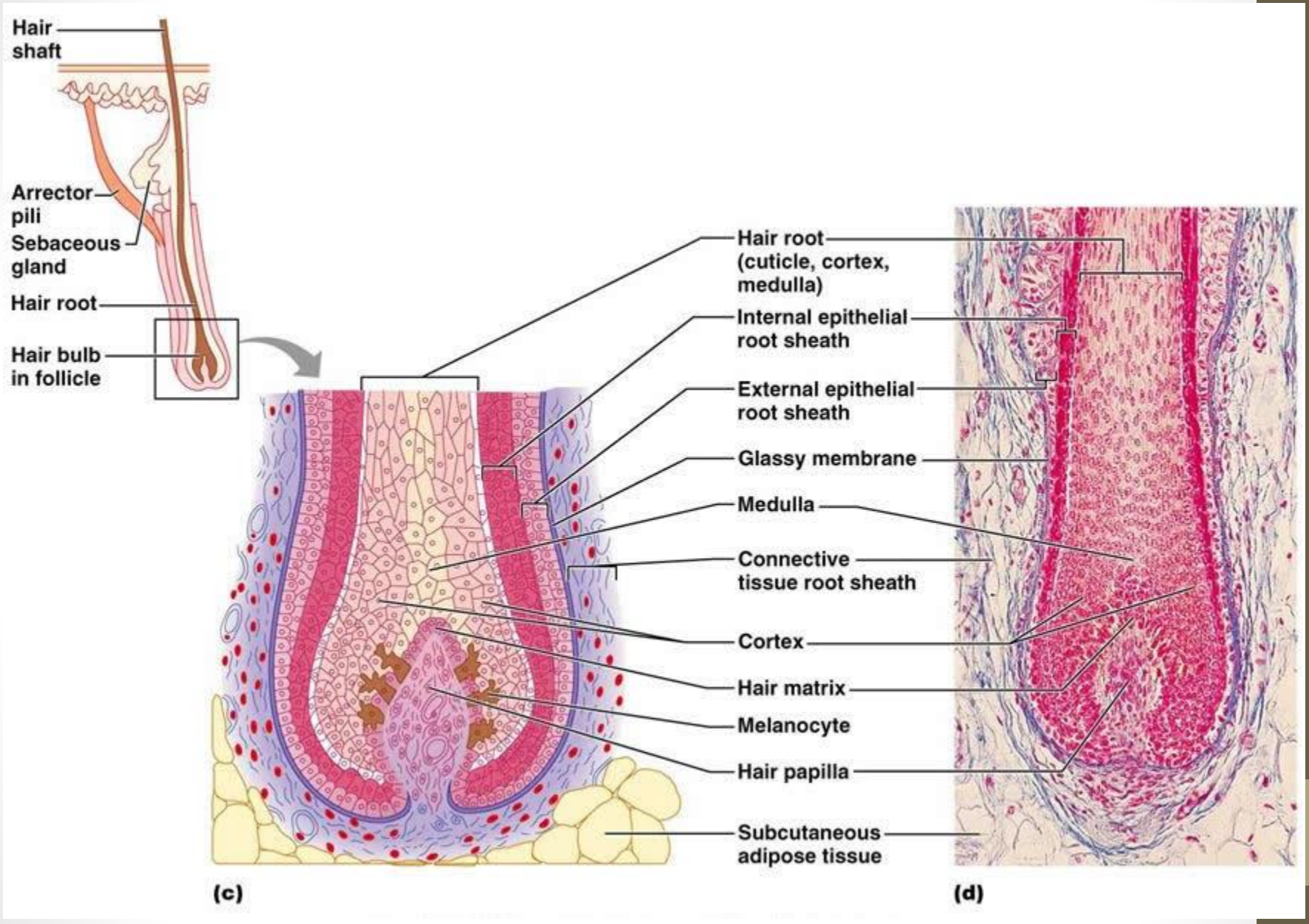
- Nails
  a. Parts: free edge, body, lunula, cuticle, nail root, nail matrix, nail bed
  b. Capillary refill = stopping of blood flow, then allowing capillaries to fill back with blood; used to check circulation


Cuticle
(eponychium)
Lateral nail fold
Free edge
Body of nail
Lunula


Cuticle
Free edge
Nail plate
Lunula
Lateral nail fold
Cuticle
Proximal nail fold
Nail plate
Nail matrix
Hyponychium
Nail bed
Nail root

Accessory Structures

- Hair
  a. Parts: follicle, root, growth matrix, bulb, shaft, melanocytes, arrector pili, sebaceous gland
  b. Function: protects head, shields eyes, collects debris (respiratory)


Hair shaft
Arrector pili
Sebaceous gland
Hair root
Hair bulb in follicle
Hair root (cuticle, cortex, medulla)
Internal epithelial root sheath
External epithelial root sheath
Glassy membrane
Medulla
Connective tissue root sheath
Cortex
Hair matrix
Melanocyte
Hair papilla
Subcutaneous adipose tissue
(c)
(d)

c. Arrector pili: muscle attached to hair follicle – contracts to create goosebumps

Accessory Structures

- Cutaneous glands / exocrine glands
  a. Sebaceous
     i. Function – lubricates skin to keep it soft and moist, kills bacteria
     ii. Location – all over body except palms and feet

a. Sweat
    i. Eccrine
        1. Function – heat regulation
        2. Location – all over body
    i. Apocrine
        1. Function – release thicker sweat in times of stress; modified glands function differently (mammary and ceruminous)
        2. Location – axillary and genital regions

Temperature Regulation

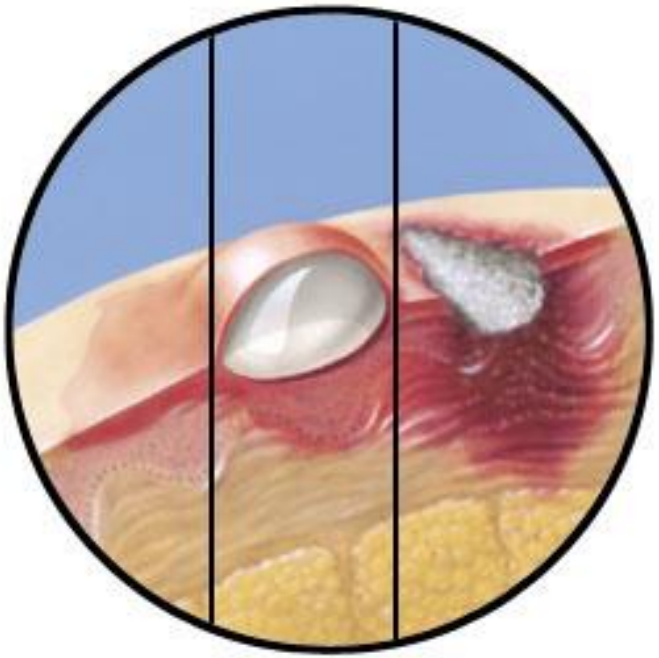
- Heat Retention = muscles contract, decrease blood flow to the skin, sweat glands become inactive

- Heat Loss = warmed blood goes to the brain, hypothalamus sends signal to dilate blood vessels and stimulate eccrine sweat glands

- http://classes.midlandstech.edu/carterp/Courses/bio210/chap05/lecture1.htm

Burn Types

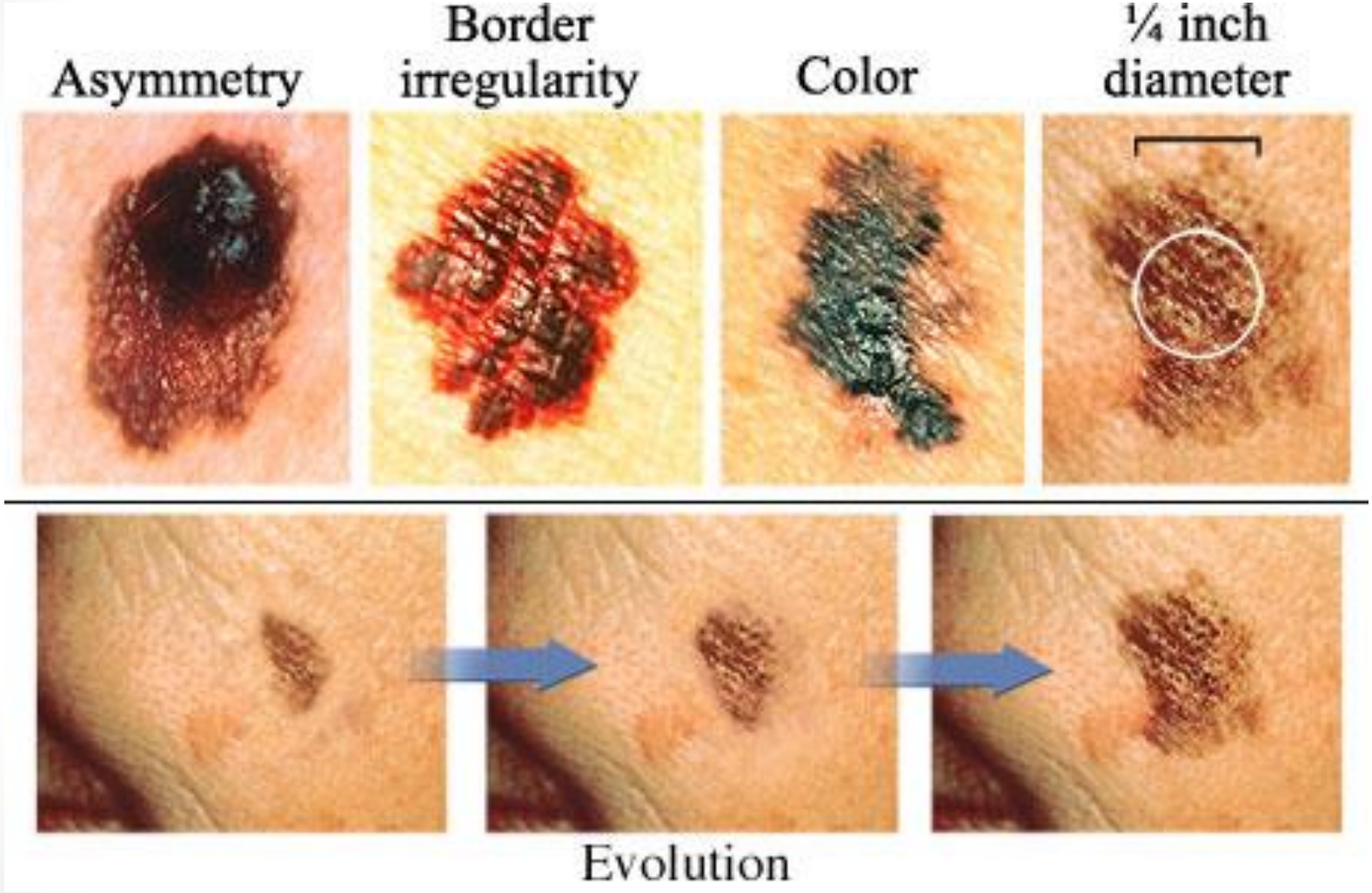
- 1st degree – only epidermis, some pain, red, swelling
- 2nd degree – epidermis and upper dermis, blisters, painful, red
- 3rd degree – entire thickness of skin, white or black, no pain


1st DEGREE
2nd DEGREE
3rd DEGREE

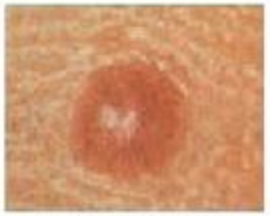
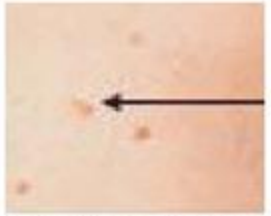
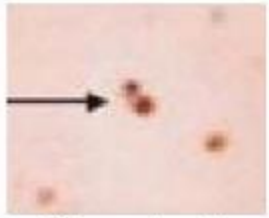
Skin Cancer

- Benign = non-cancerous
- Malignant = cancerous

- ABCD rule: Asymmetry, Border irregularity, Color, Diameter


Asymmetry
Border irregularity
Color
¼ inch diameter
Evolution

The ABCDEs of Detecting Melanoma

	A Asymmetry	B Border	C Color	D Diameter	E Evolving
NORMAL	 Symmetrical	 Borders Are Even	 One Color	 Smaller Than 1/4 Inch	 Ordinary Mole
MELANOMA	 Asymmetrical	 Borders Are Uneven	 Multiple Colors	 Larger Than 1/4 Inch	 Changing in Size, Shape and Color

- Types:
  - Squamous cell carcinoma: stratum spinosum
  - Basal cell carcinoma: stratum basale – most common
  - Melanoma: cancer of melanocytes

Development

- Fetal Development and Infancy
  - 5th and 6th month (fetal) = downy type hair covers body (lanugo)
  - At birth = covered with cheese-like substance produced by the sebaceous glands (milia)
- Adolescence = increase oil production, acne, glands become activated
- Old Age = decrease fat – less tolerant to cold, decrease elasticity of skin, hair loss

Lanugo Hair at 29 Weeks

Wound Healing

- Inflammatory response = nonspecific response that attempts to prevent spread of injury
  - Symptoms = redness, swelling, pain, increase temperature
- Immune response = extremely specific response to antigens

- Regeneration = regrowth of normal tissue
- Fibrosis = scar tissue formation

Wound Healing

- Whether regeneration or fibrosis occurs depends on:
  - Type of tissue injured and severity of the injury
- Ability of different tissue types to regenerate:
  - nervous/muscle = no regrowth
  - Bone = very likely to regrow

Wound Healing

- Phase 1
  - Injury occurs and skin/tissue has been injured
  - Capillaries become permeable – open up
  - Clotting proteins rush into the injured area from the blood
  - Proteins (platelets) form a clot
  - Where clot is exposed to air it dries and hardens becoming a scab

Wound Healing

- Phase 2
  - Granulation tissue forms under the scab, which is full of capillaries making it soft and delicate
  - Granulation tissue contains phagocytes (breakdown clot) and fibroblasts (make scar tissue)
  - Surface epithelium regenerates and makes its way across the granulation tissue until the scab detaches and wound is healed

Video

- Wound Healing