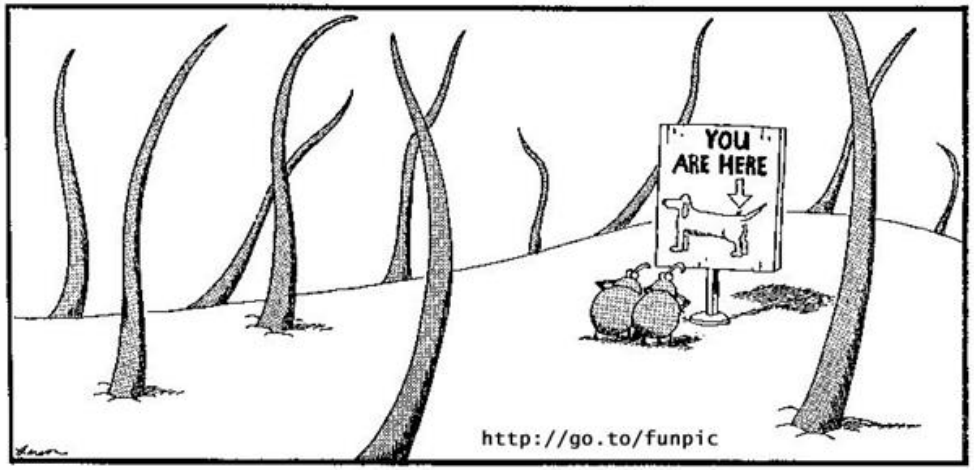
Animal Anatomy and Physiology 1

Webinar Chapter 5

Skin and Related Structures



The Integument and Related Structures
Chapter 5

Pages 131-152

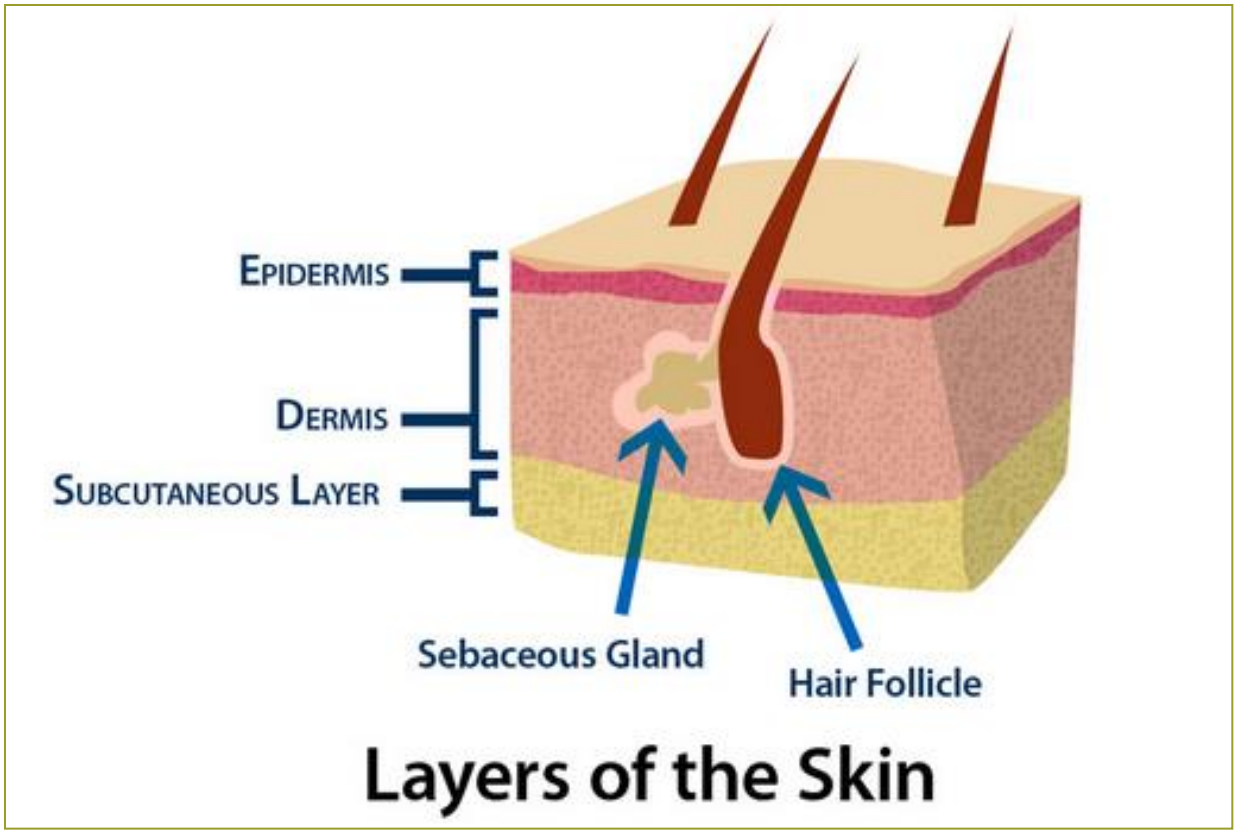
Textbook Learning Objectives

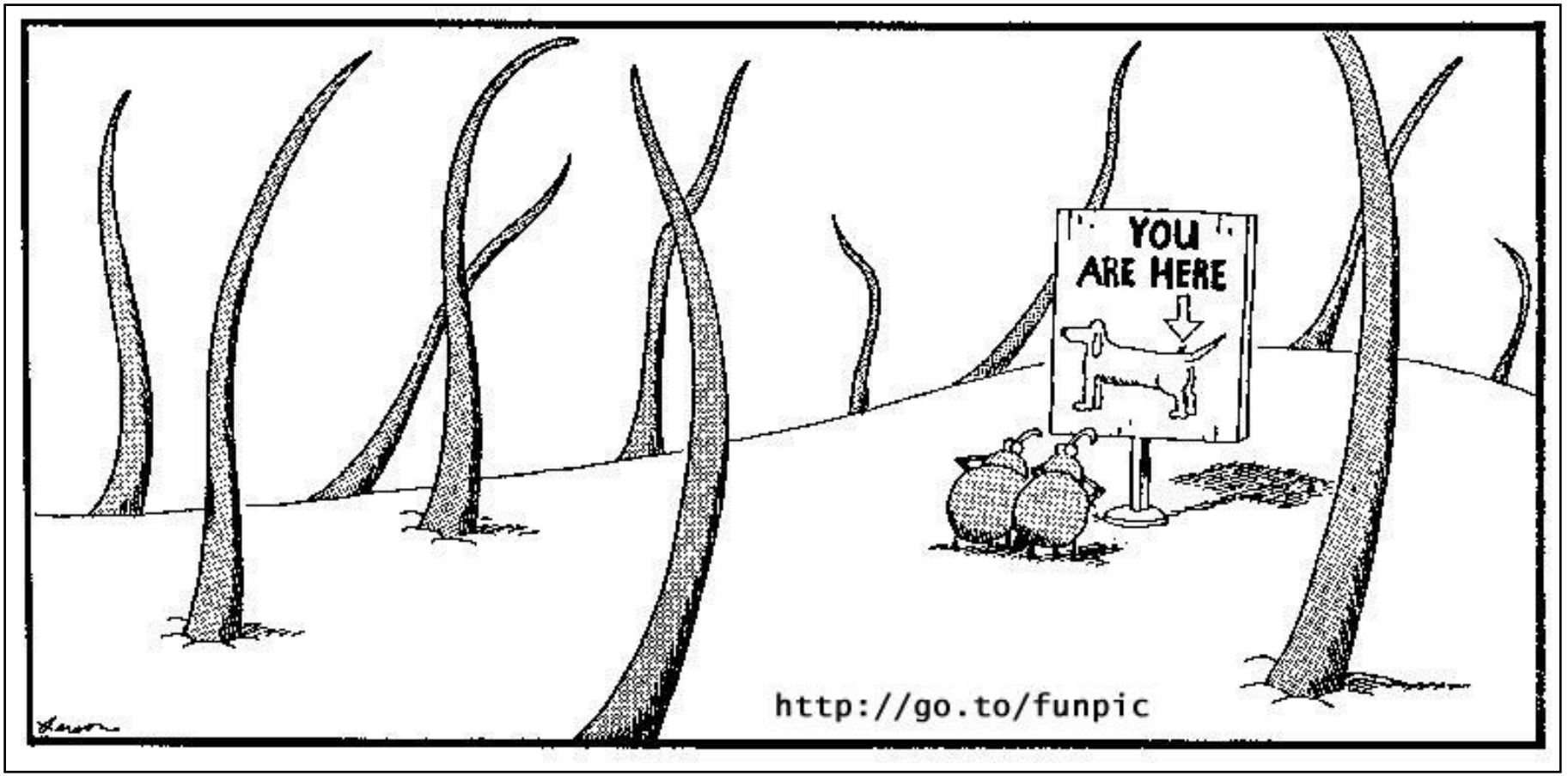
Chapter 5 – Page 131

- List the cell types that make up the epidermis and describe the function of each cell type.
- List the five layers of the epidermis.
- Describe the process of keratinization.
- List the structures that constitute the dermis and describe the function of each.
- List the structures of the hypodermis.
- Describe the unique features of the paw pads and planum nasale.
- Describe the parts of the hair follicle and explain how hair grows.
- List and describe the three types of hair.
- Describe the structure and location of sebaceous glands.
- Differentiate between eccrine and apocrine sweat glands.

Topic 20

Describe the structures and functions of the three layers of skin

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Overview

- Dermatology
- Integumentary System
  - Skin
  - Adnexa (related structures)
    - Hair, hooves, horns, claws, skin-related glands
- Skin continous with mucous membranes that line body openings
- Remarkable ability to regenerate & heal

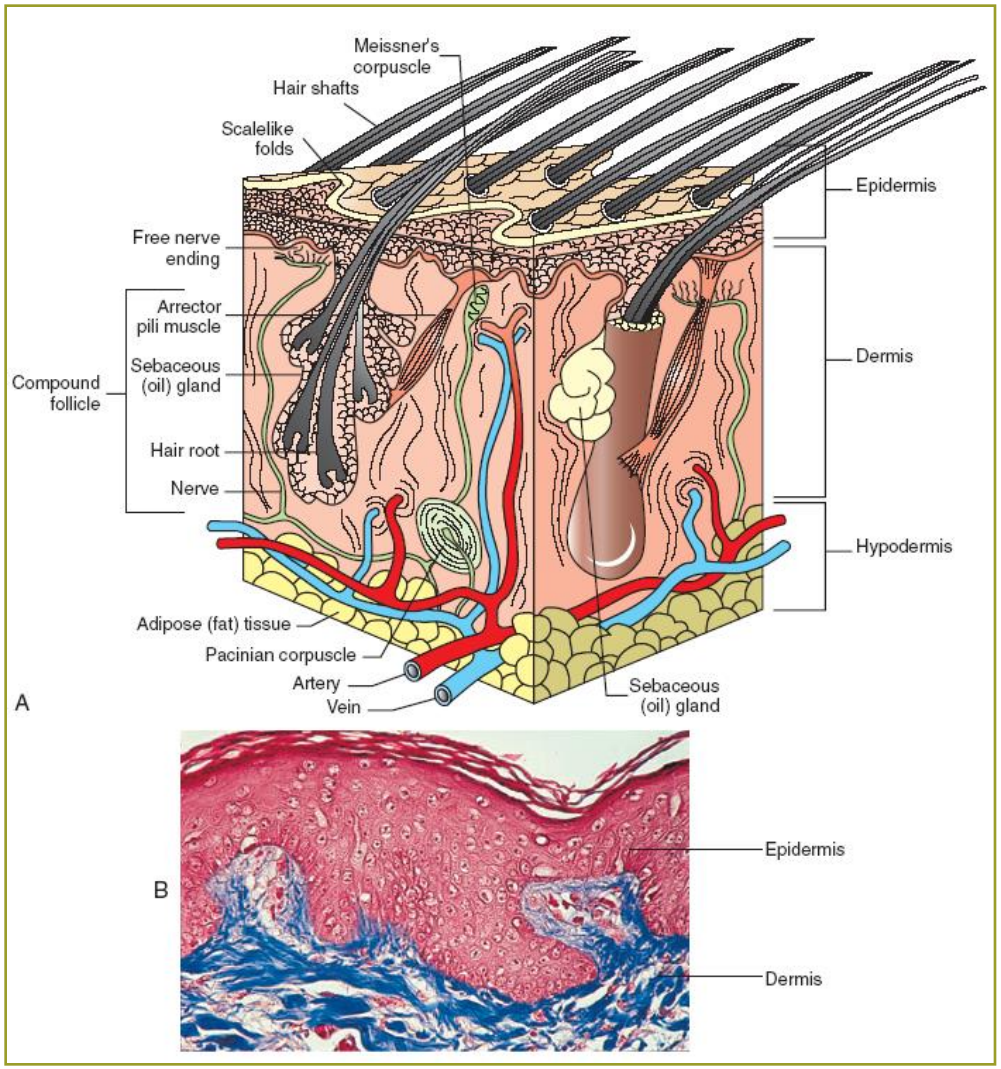
Functions of Skin

- Covering (waterproofing) for animal body
  - Part of animal body's **first line of defense**
- Protection from trauma, temperature change, entrance of pathogens
- Makes vitamin D
- Sensory organ
- Heat-regulating organ in cats, horses
- Excretes water & salt

Integumentary System

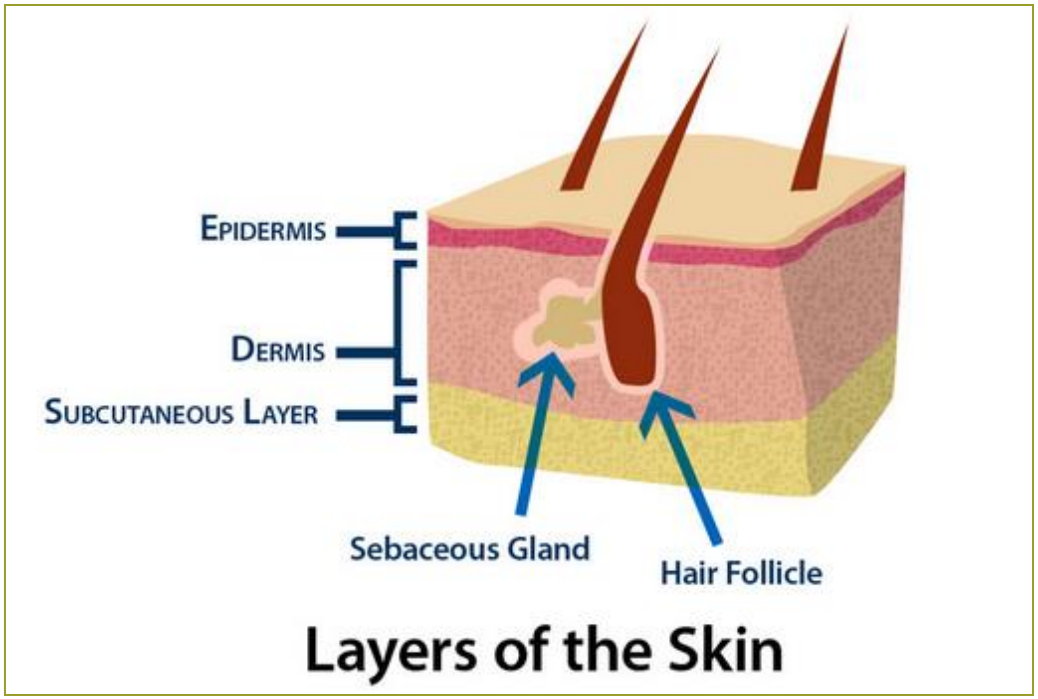
Figure 5-1, Page 132

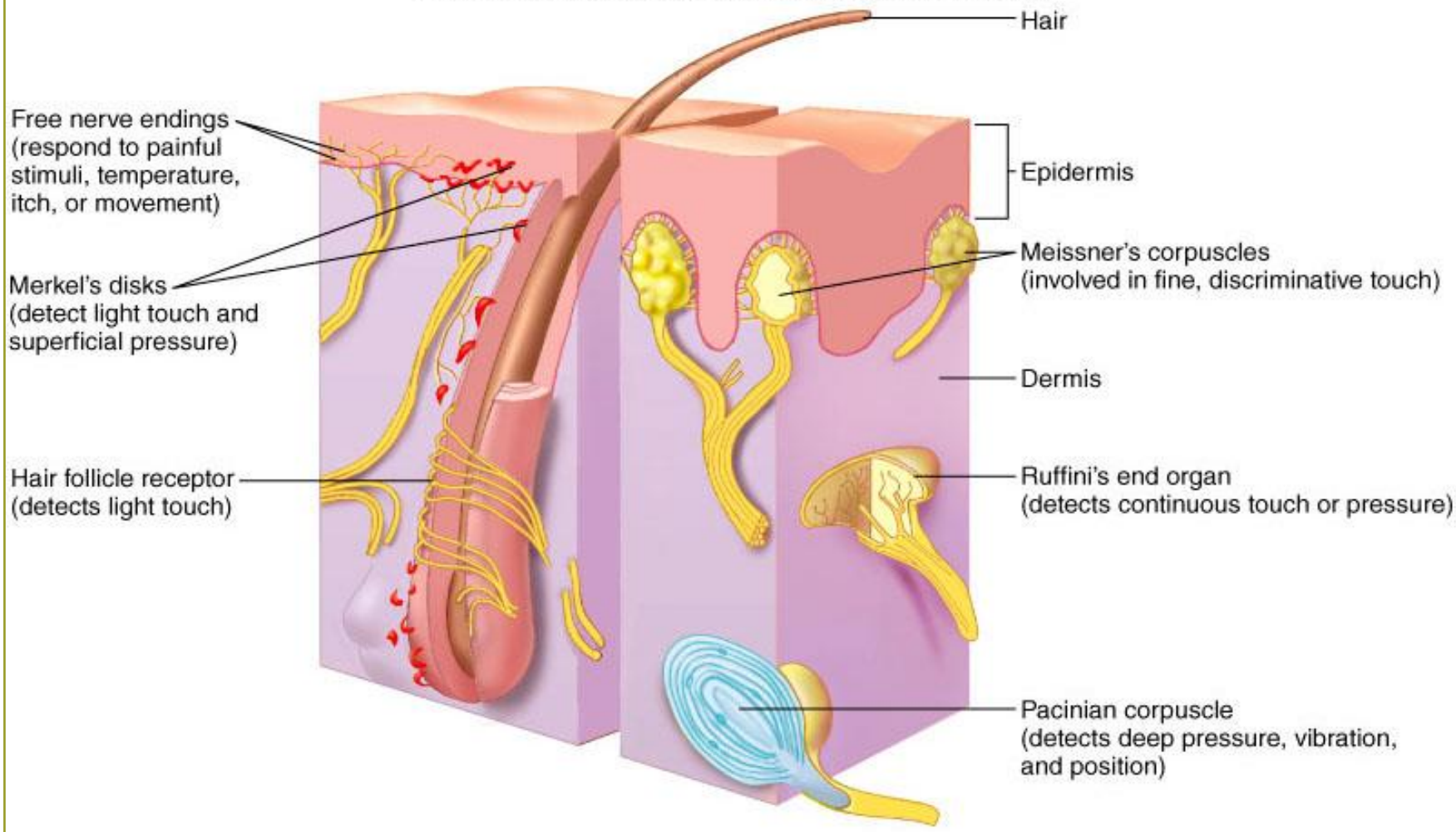
- Consists of three layers:
  - Epidermis
  - Dermis
  - Hypodermis

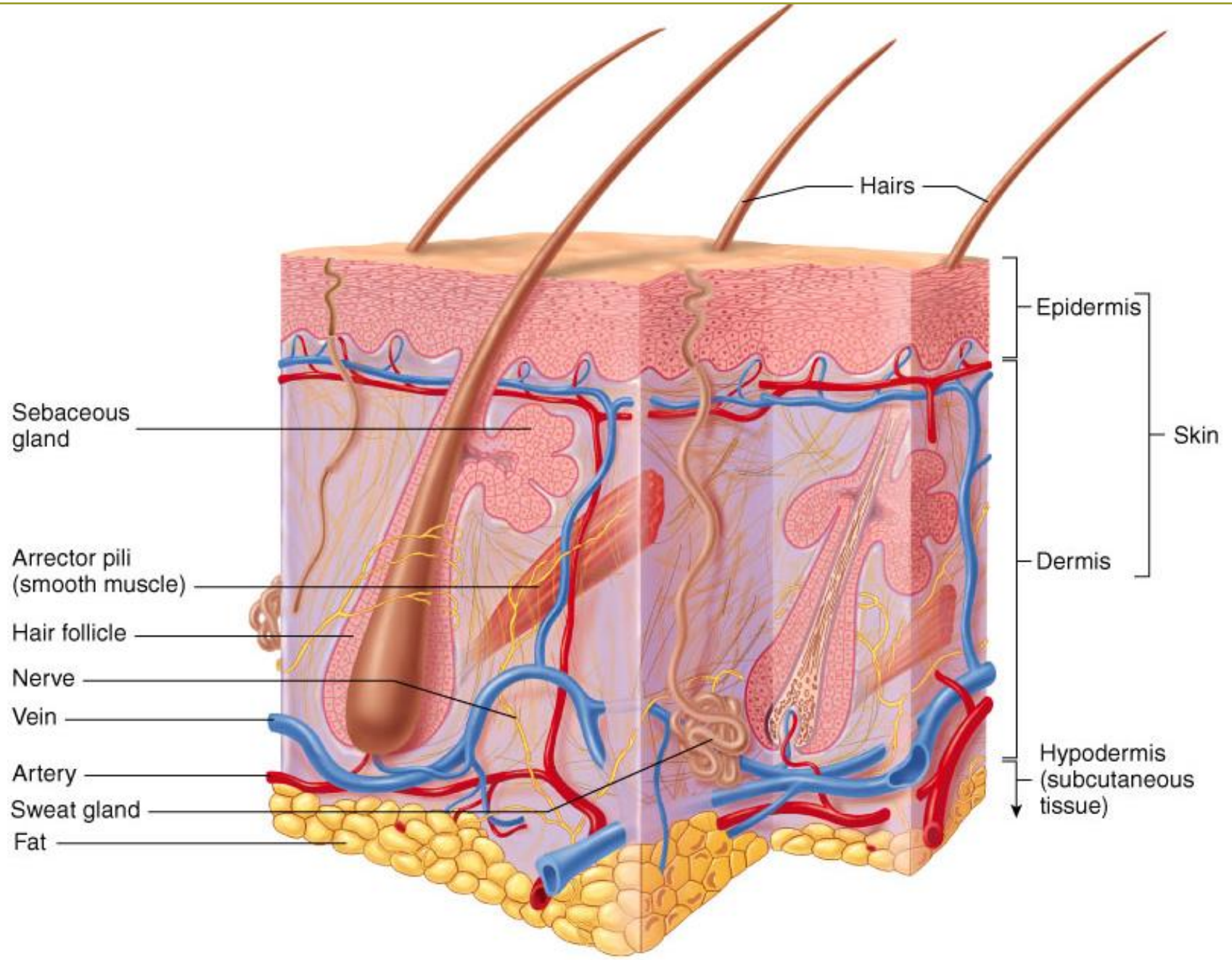


Anatomy of Canine Skin

- 3 distinct layers
  - Epidermis
  - Dermis
  - Hypodermis (subcutaneous)
    - Adipose tissue
- Related structures

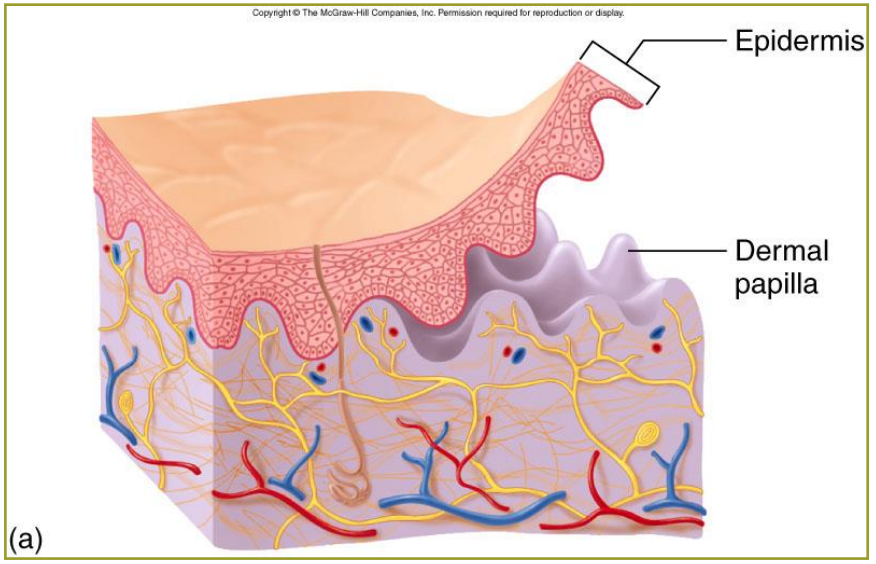


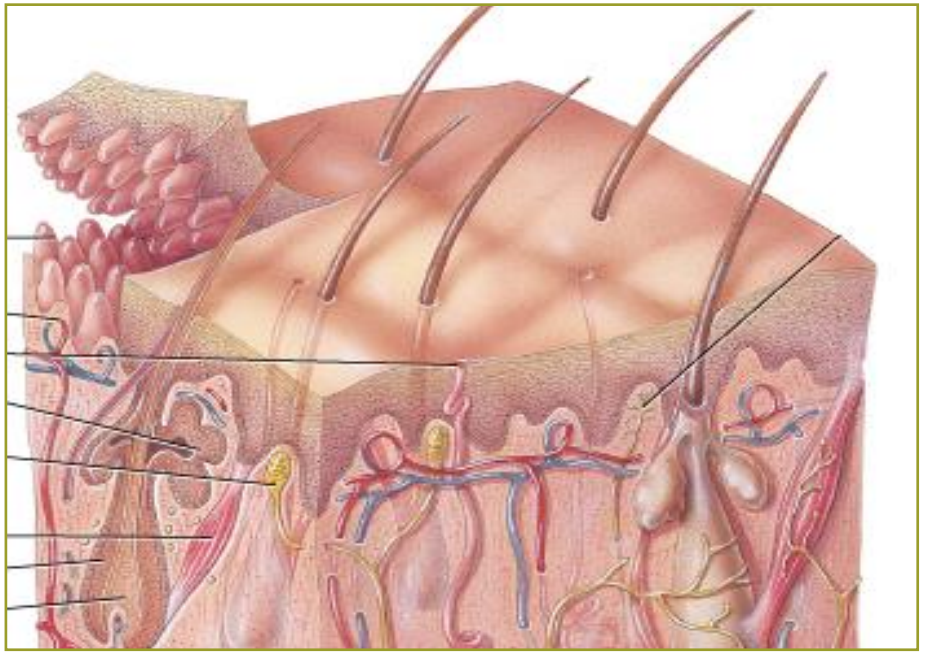



Hairs
Epidermis
Skin
Dermis
Hypodermis
(subcutaneous
tissue)
Sebaceous
gland
Arrector pili
(smooth muscle)
Hair follicle
Nerve
Vein
Artery
Sweat gland
Fat

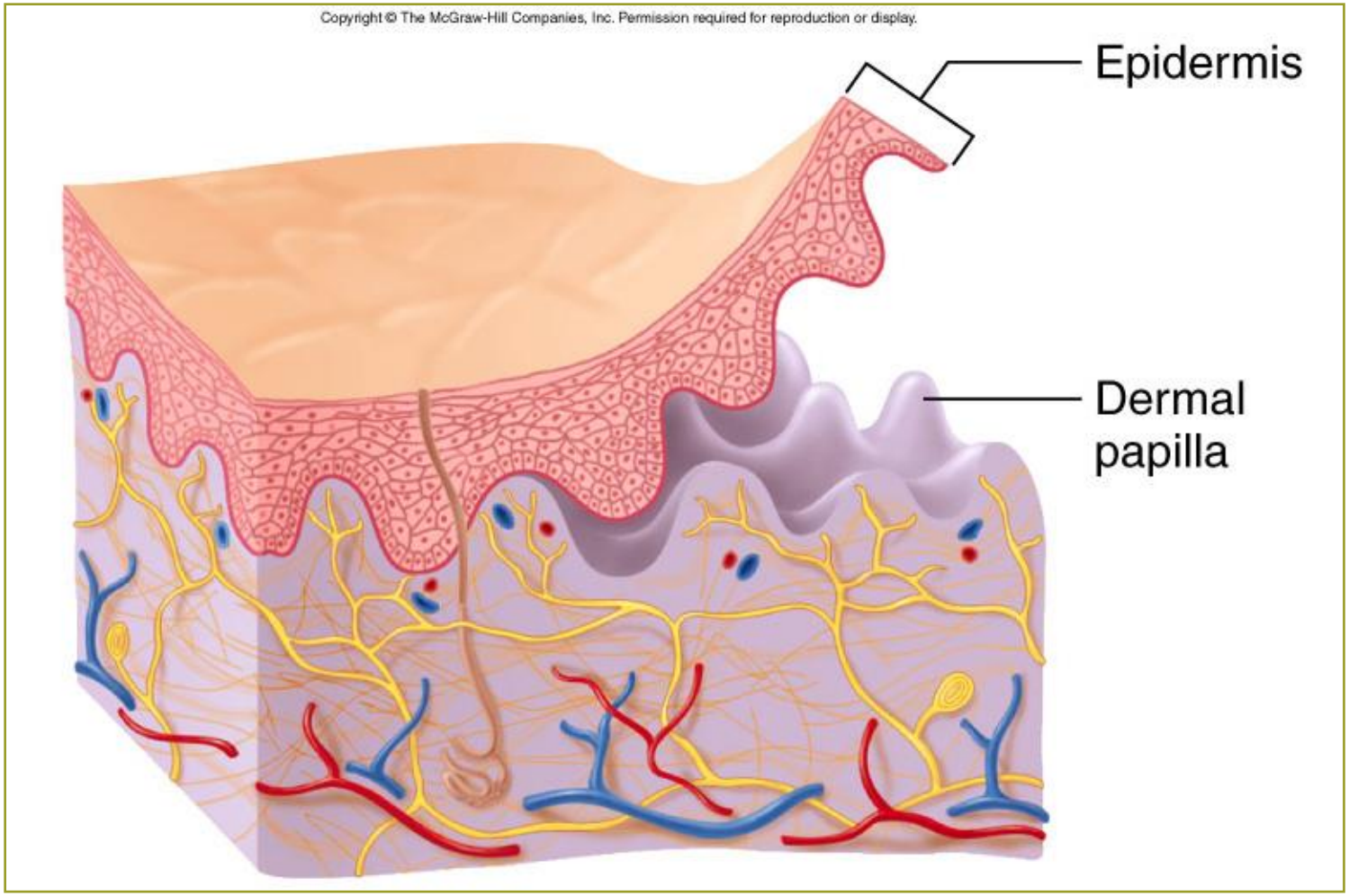
Epidermis

- Most **superficial** layer
  - Thin, cellular
  - Nerve supply, no blood supply
  - Constantly growing, constant mitosis





Epidermis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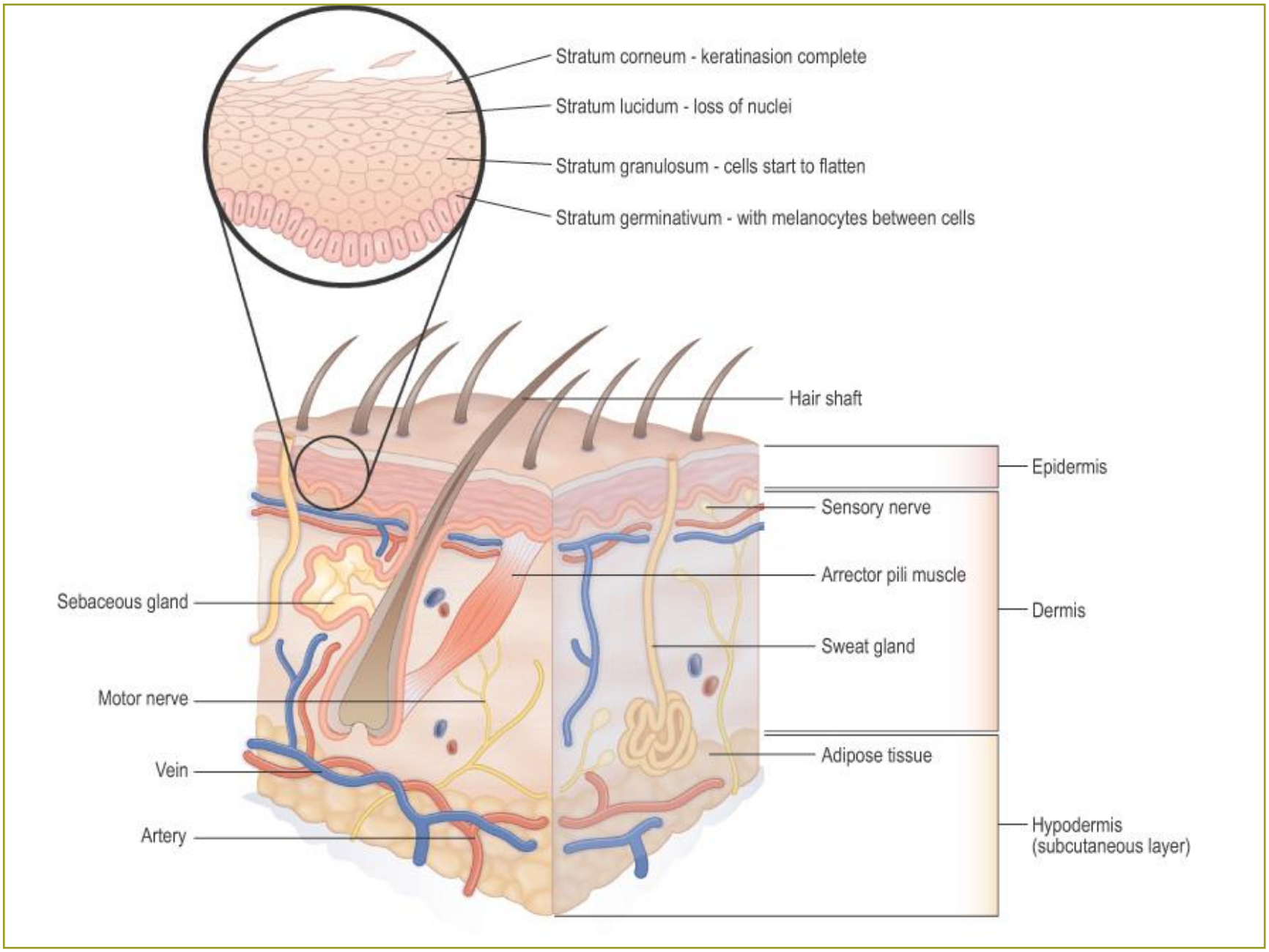
Epidermis
Dermal papilla

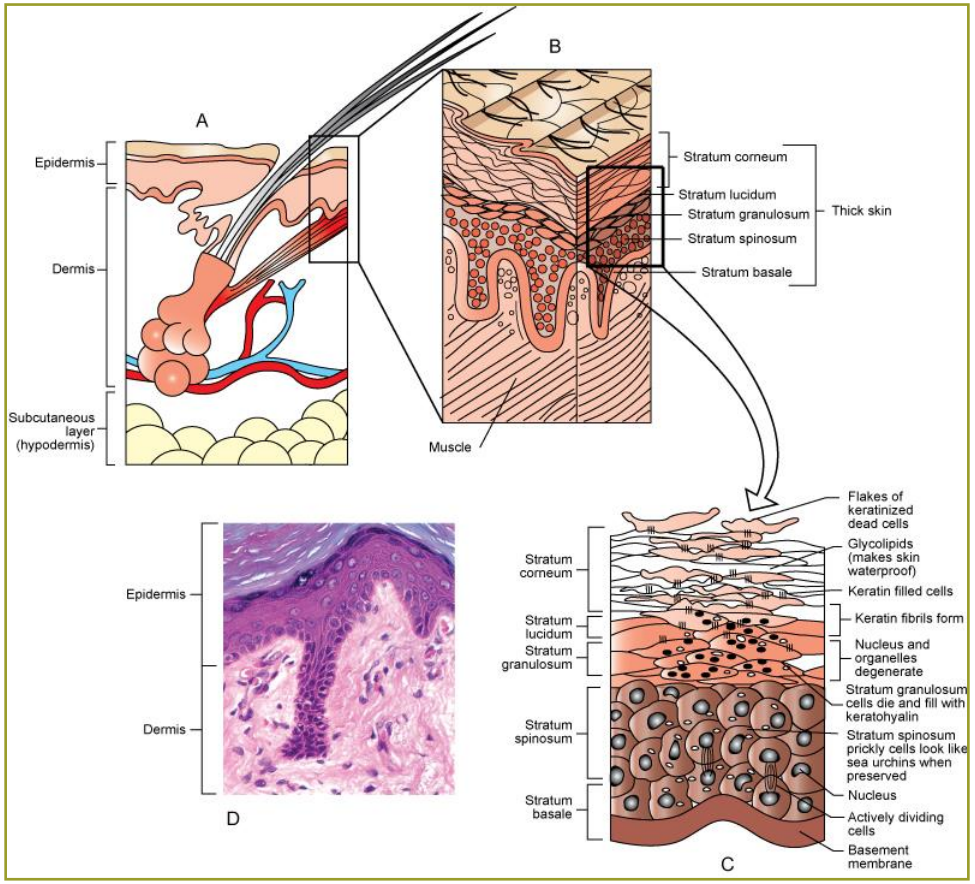

Stratum corneum - keratinasion complete
Stratum lucidum - loss of nuclei
Stratum granulosum - cells start to flatten
Stratum germinativum - with melanocytes between cells
Hair shaft
Epidermis
Sensory nerve
Arrector pili muscle
Sebaceous gland
Dermis
Sweat gland
Motor nerve
Adipose tissue
Vein
Artery
Hypodermis
(subcutaneous layer)

5 Layers of Epidermis

1. Stratum Germinativum

Figure 5-2, Page 134

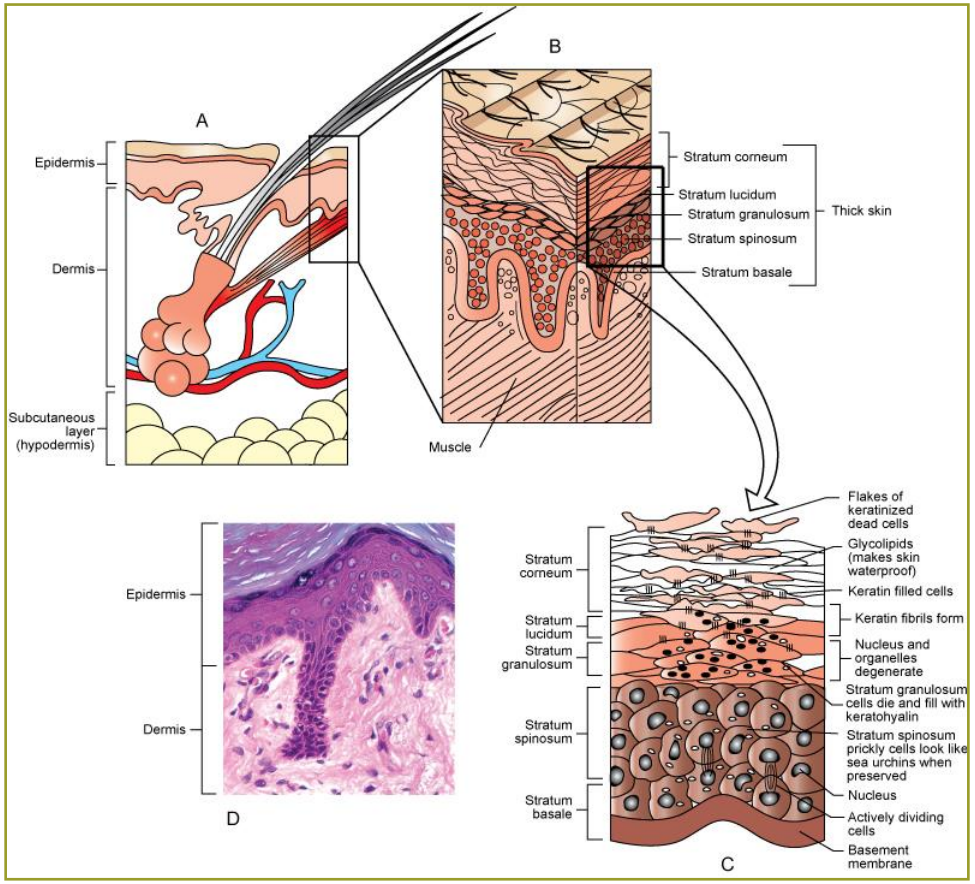
- Deepest layer
- Consists of a single row of keratocytes attached to epithelial basement membrane
- Merkel cells, melanocytes, keratocytes, found in this layer



2. Stratum Spinosum

Figure 5-2, Page 134

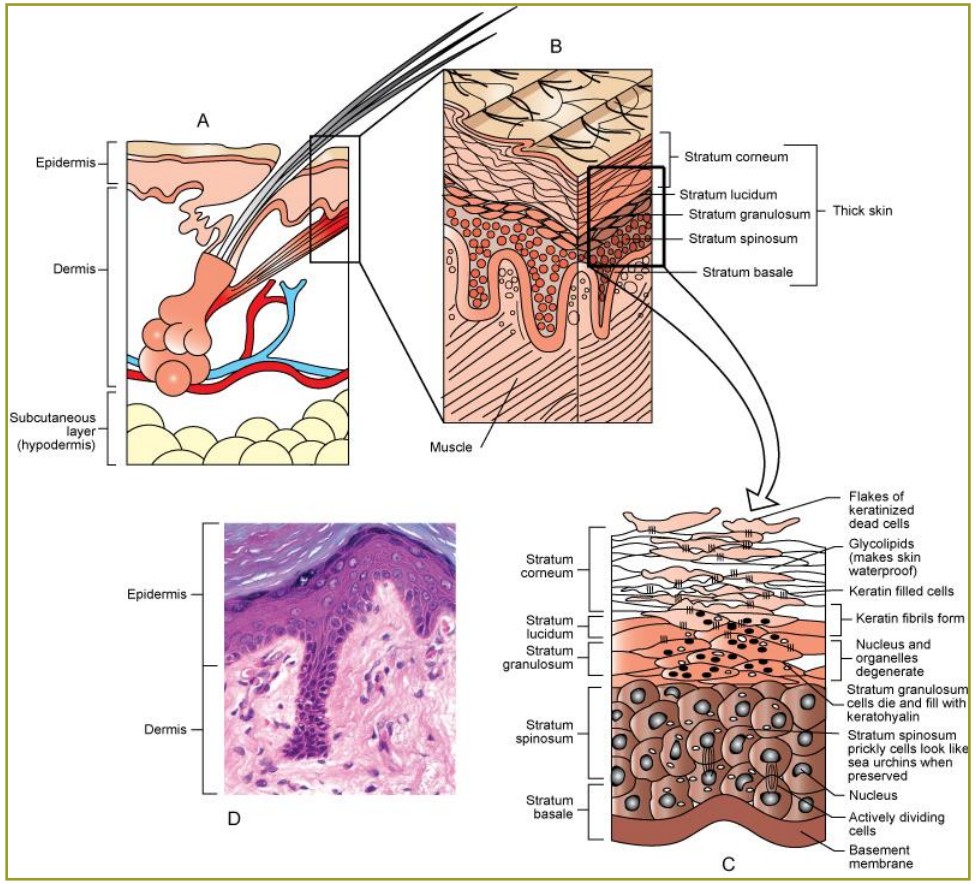
- Contains several layers of cells held together by desmosomes
- Langerhans cells found in this layer



3. Stratum Granulosum

Figure 5-2, Page 134

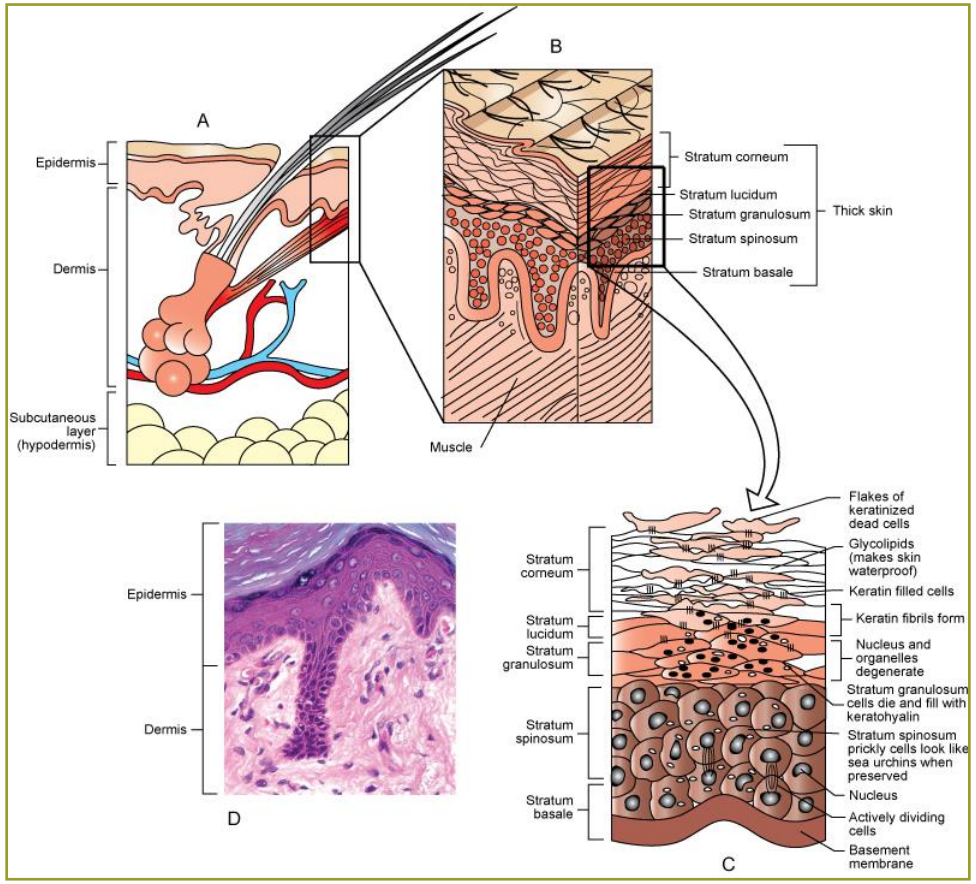
- Composed of two to four layers of flattened, diamond-shaped keratocytes that contain lamellated granules of glycolipids
- These glycolipids play a role in helping waterproof the skin and slowing water loss across the epidermis



4. Stratum Lucidum

Figure 5-2, Page 134

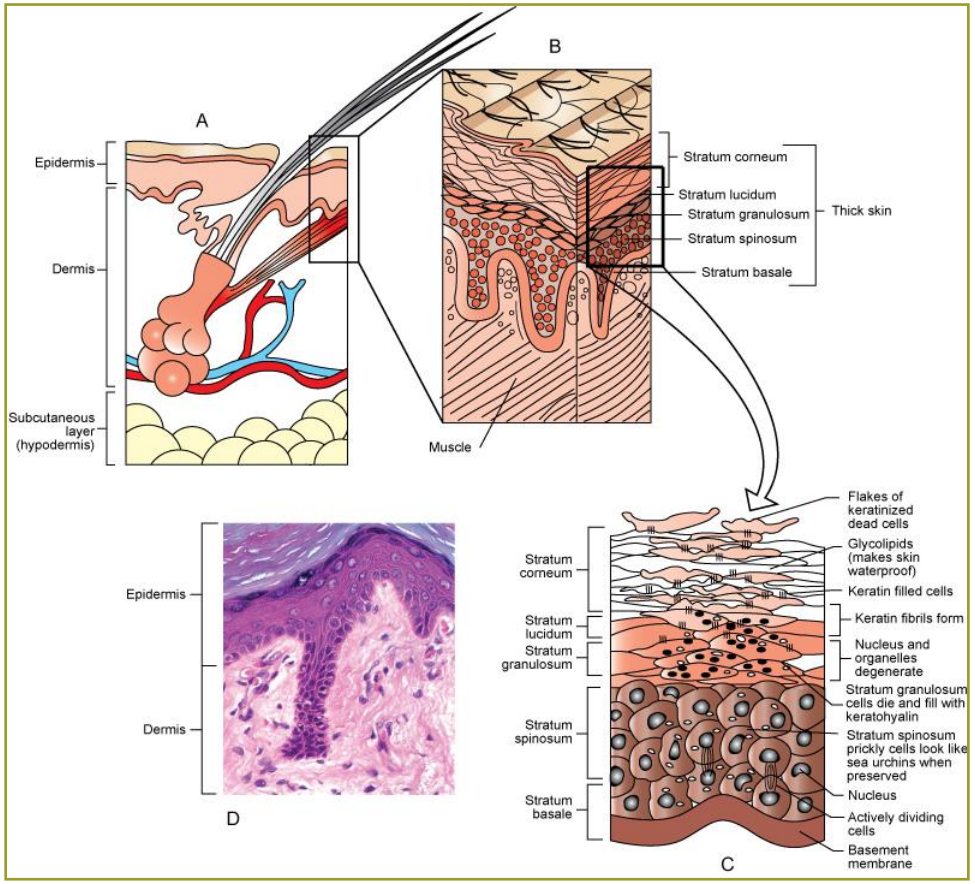
- Found in very thick skin
- Composed of a few rows of flattened dead cells
- Contents of the keratogranules combine with intracellular tonofilaments to form keratin fibrils



5. Stratum Corneum

Figure 5-2, Page 134

- Horny outermost layer
- Composed of 20 to 30 rows of keratocyte "remnants"
  - Sometimes called *horny* or ***cornified*** *cells*



Epidermis of Hairy Skin

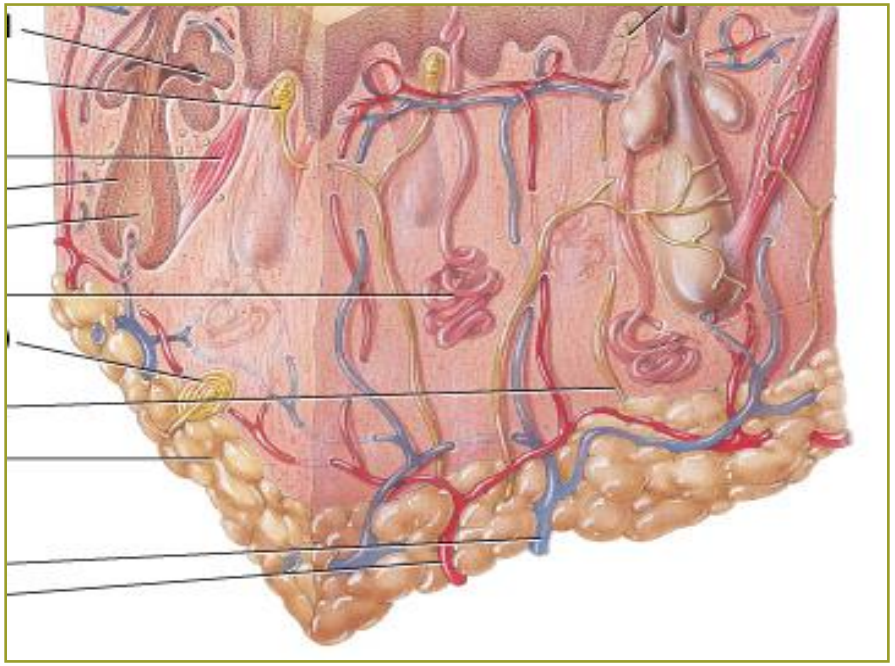
- Hairy skin usually consists of three epidermal layers rather than five (stratum basale, stratum spinosum, and stratum corneum)
- The surface of hairy skin is covered in scalelike folds
- A knoblike elevation can be seen periodically
  - Tactile elevation or epidermal papilla
  - Usually associated with a tactile hair (tylotrich hairs)

Epidermis Gives Rise To Following Structures

- Hair
- Feathers
- Glands
- Paw pads
- Nails, horns, beaks

Dermis

- **Greatest portion of integument**
- Much fibrous connective tissue
  - Few cells, lots of matrix
  - Gives strength to skin
- Good nerve & blood supply
- Used to make leather (the "**hide**")



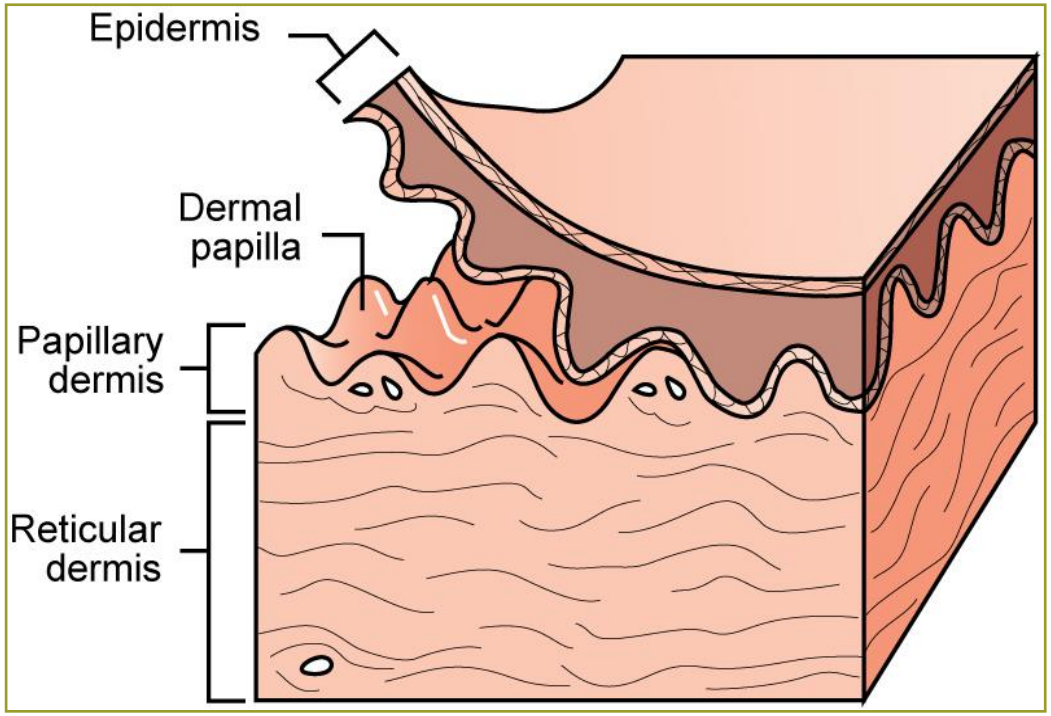
Dermis

- Also includes hair follicles, nerve endings, glands, smooth muscle, blood vessels, and lymphatics
- Two layers:
  - **Papillary layer**
  - **Reticular layer**

Papillary Layer

Figure 5-4, Page 138

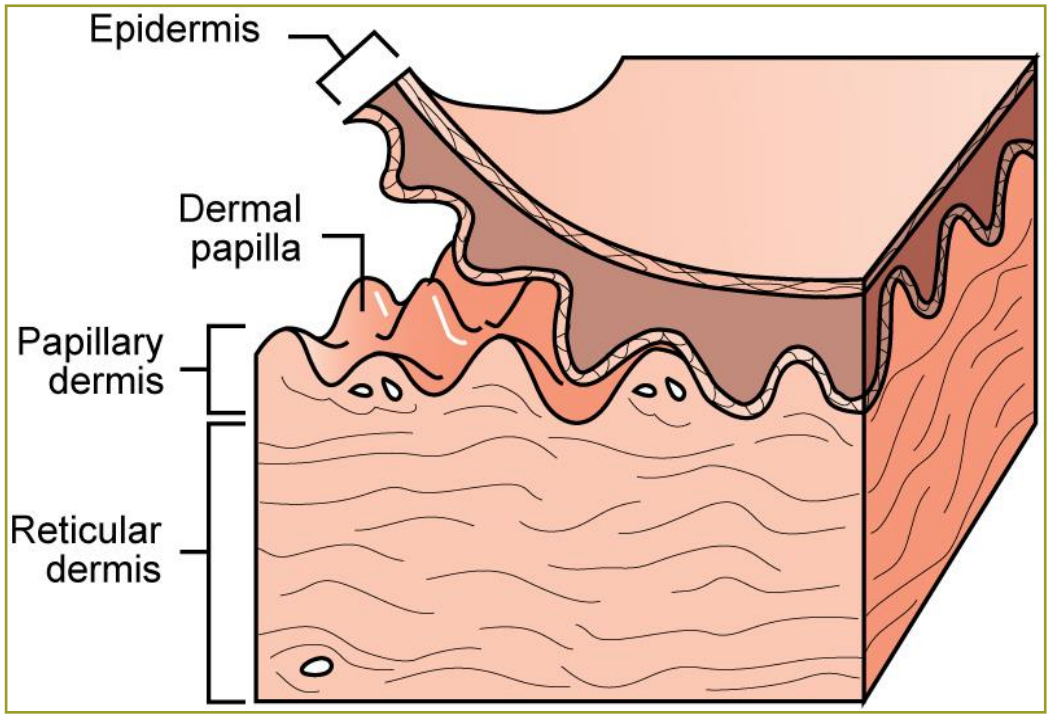
- Underneath the epithelial layer of the epidermis
- Dermal papillae help cement the epidermis and the dermis together
- Blood vessels, pain, temperature, and touch receptors also present



Reticular Layer

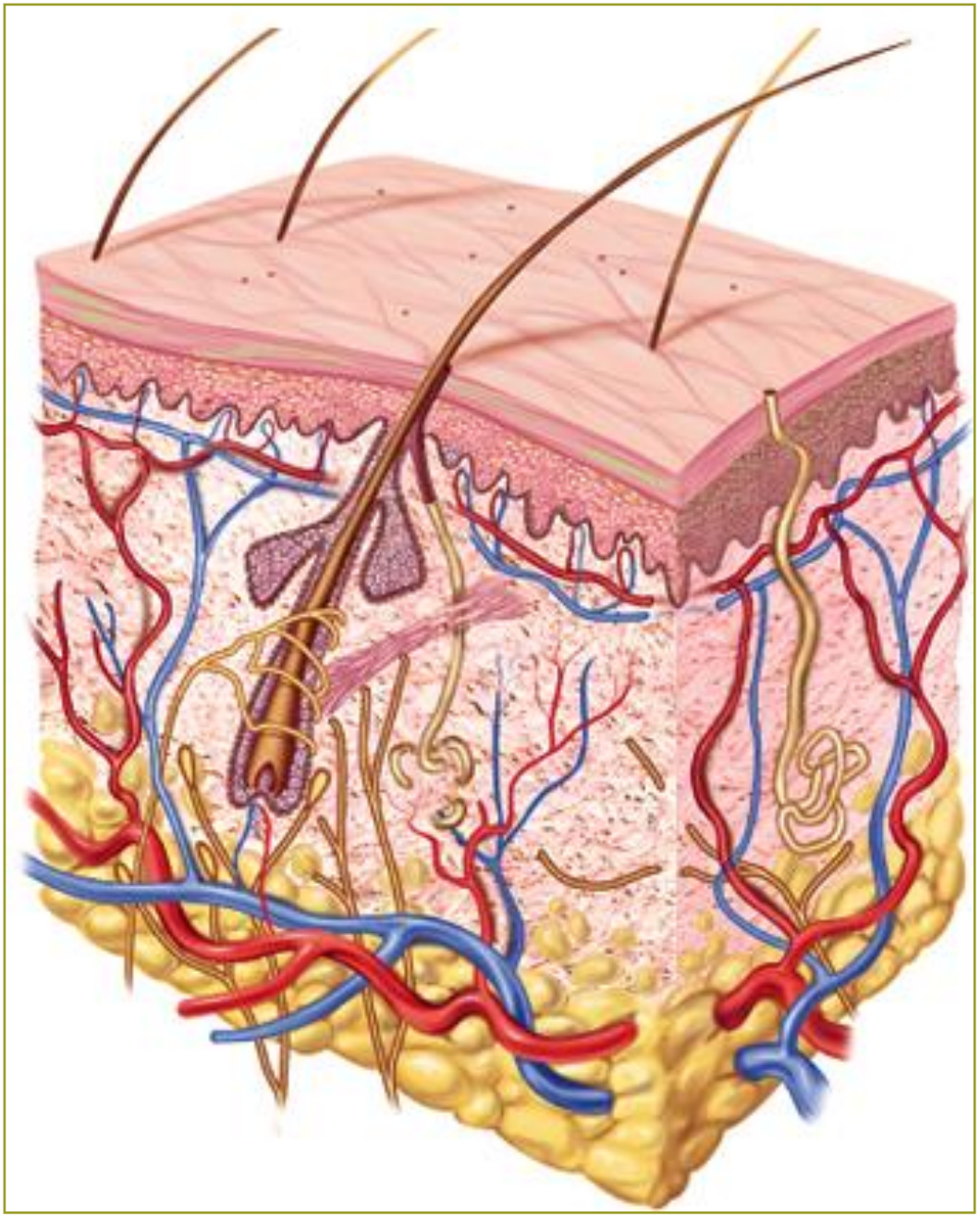
Figure 5-4, Page 138

- Consists of dense irregular connective tissue



Hypodermis

- Subcutaneous layer
- Thick layer
- Permits free movement of skin
- 24% of body weight of newborn puppy
- 12% of adult body weight



Hypodermis

- Composed of areolar tissue containing adipose, blood and lymphatic vessels, and nerves
- Contains special touch receptor – the *pacinian corpuscle (*sensitive to heavier pressure than Meissner's corpuscle)
- Fibers of hypodermis are continuous with those of dermis
- Hypodermal layer permits skin to move freely over underlying bone and muscle without putting tension on skin

Clinical Application! What Is Mange Anyway?

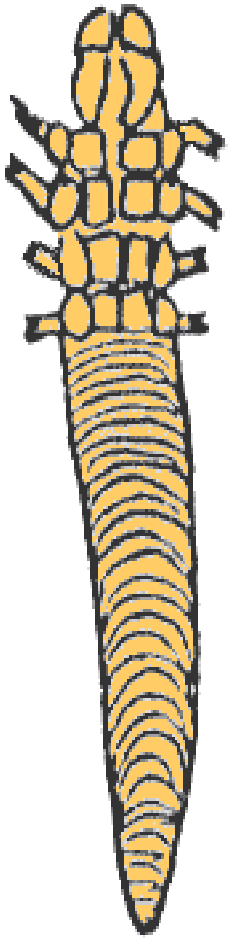
Pages 136-137

Sarcoptic Mange

- Burrows through epidermis
- Zoonosis
  - "Scabies"

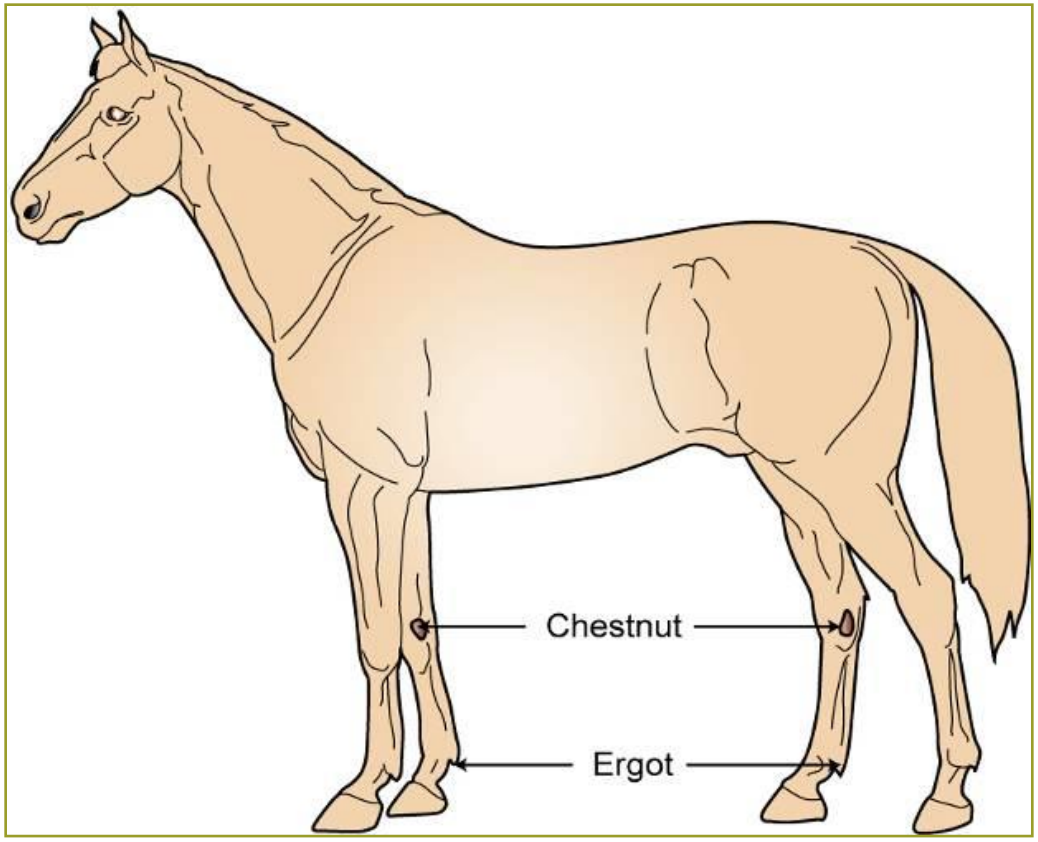
Demodectic Mange

- Lives at base of hair follicles
- Not a zoonosis



Topic 21

Discuss the special features found in the integument



Special Features of the Integument

- Pigmentation
- Paw Pads
- Planum Nasale
- Ergots and Chestnuts
- Cutaneous Pouches in Sheep

Pigmentation

- Result of presence or absence of **melanin** granules in the extensions of melanocytes
  - No pigmentation if granules are concentrated around nucleus of the melanocyte
  - As granules move into the cellular extensions and into surrounding tissue, pigmentation becomes macroscopically apparent
- The more granules present, the darker the pigmentation

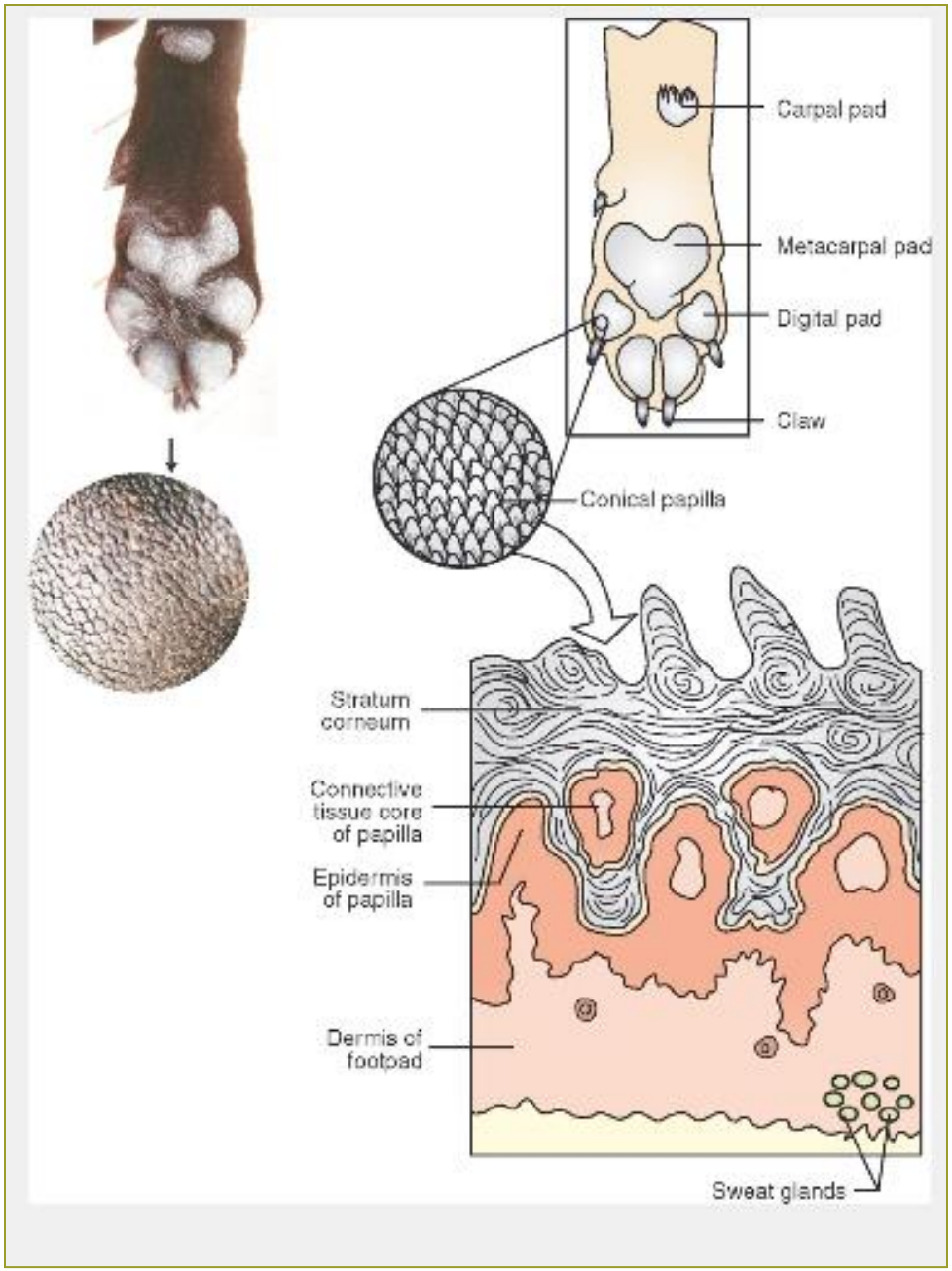
Paw Pads

Figure 5-5, Page 140

- Thick layers of fat & connective tissue
- Outer surface is toughest & thickest skin in animal's body
- Often pigmented; composed of all five epidermal layers
  - **Stratum corneum** is thicker than all other layers combined
- Exocrine & sweat glands

Paw Pads

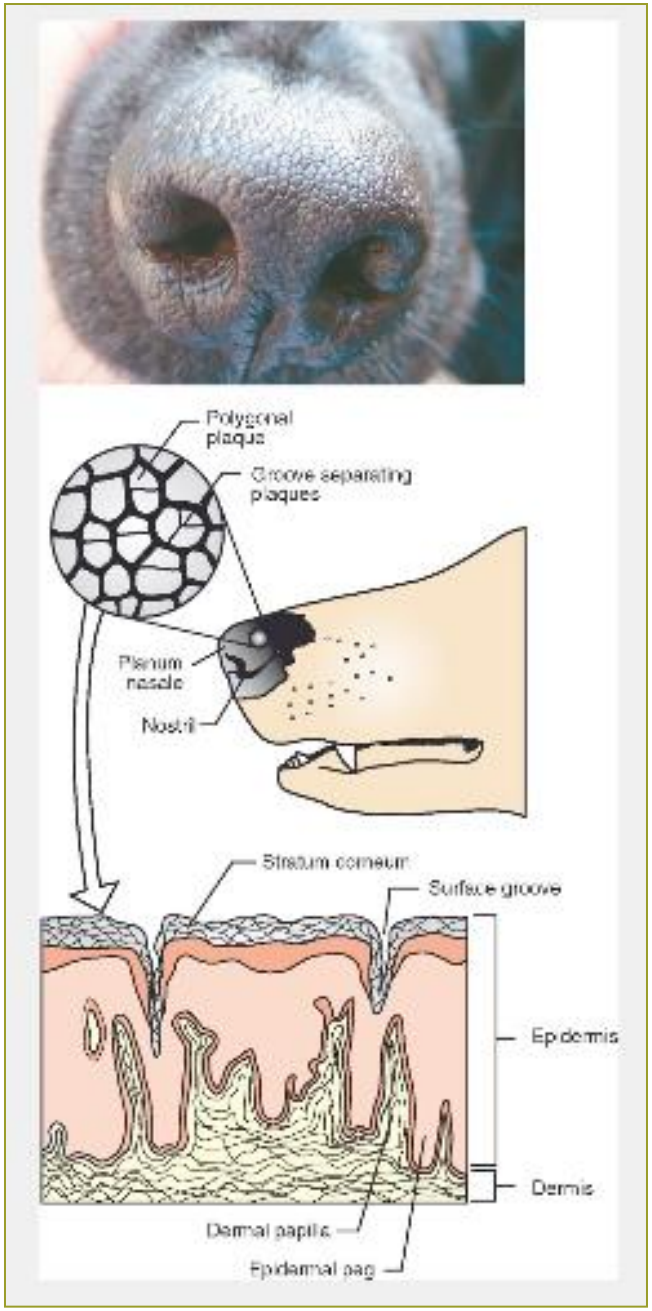
Figure 5-5, Page 140



Planum Nasale

Figure 5-6, Page 141

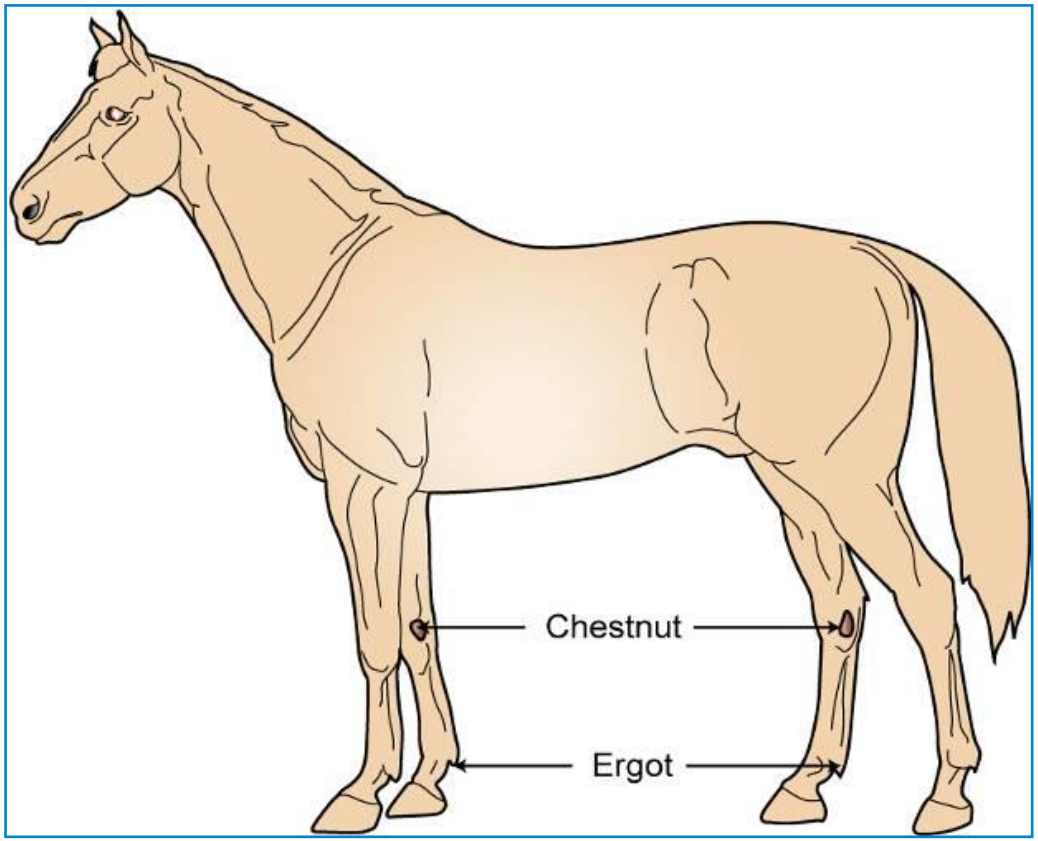
- Top of the nose in cats, pigs, sheep, and dogs
- Wet or dry not a health indicator
- Usually pigmented
  - ("Collie Nose")



Ergots and Chestnuts

Figure 5-7, Page 141

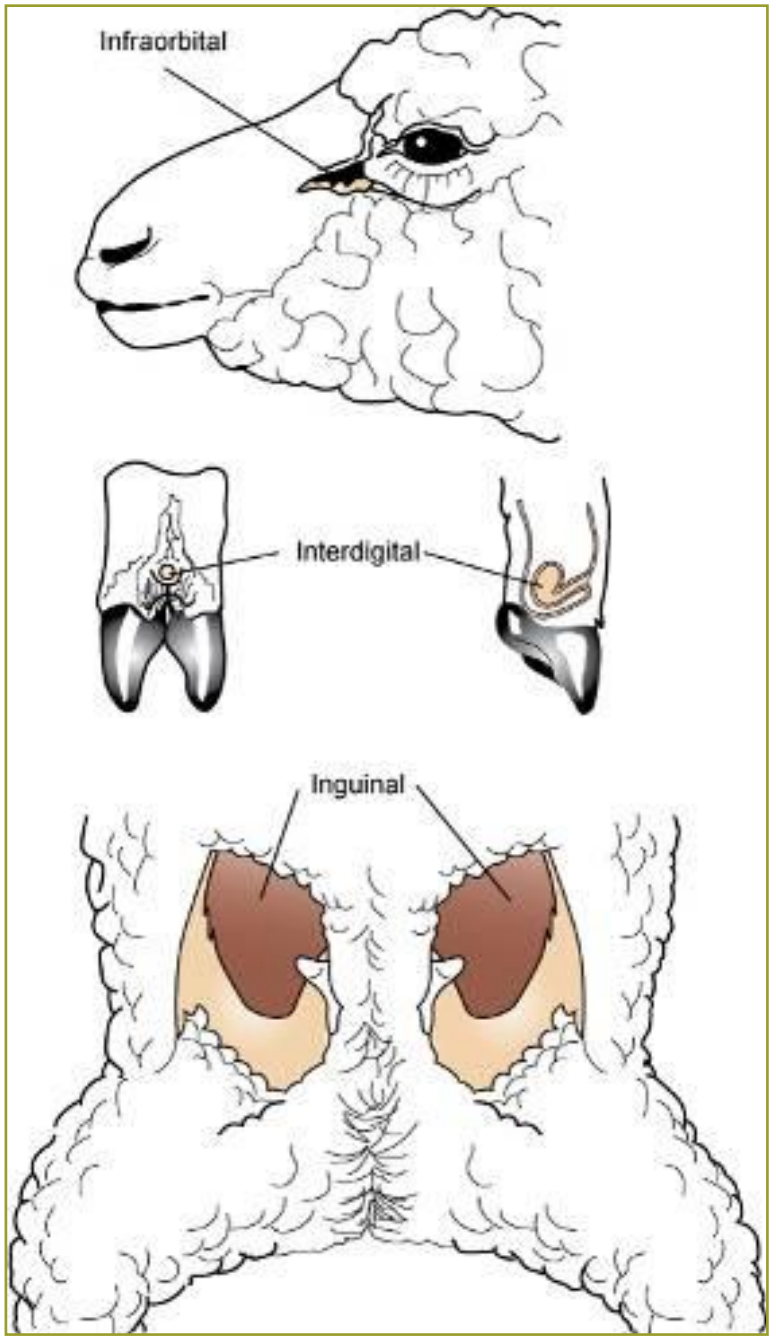
- Dark horny structures found on inside legs of horses, ponies, and other equidae
- Thought to be vestiges of carpal and tarsal pads of second and fourth digits
  - ("splint bones")



Cutaneous Pouches in Sheep

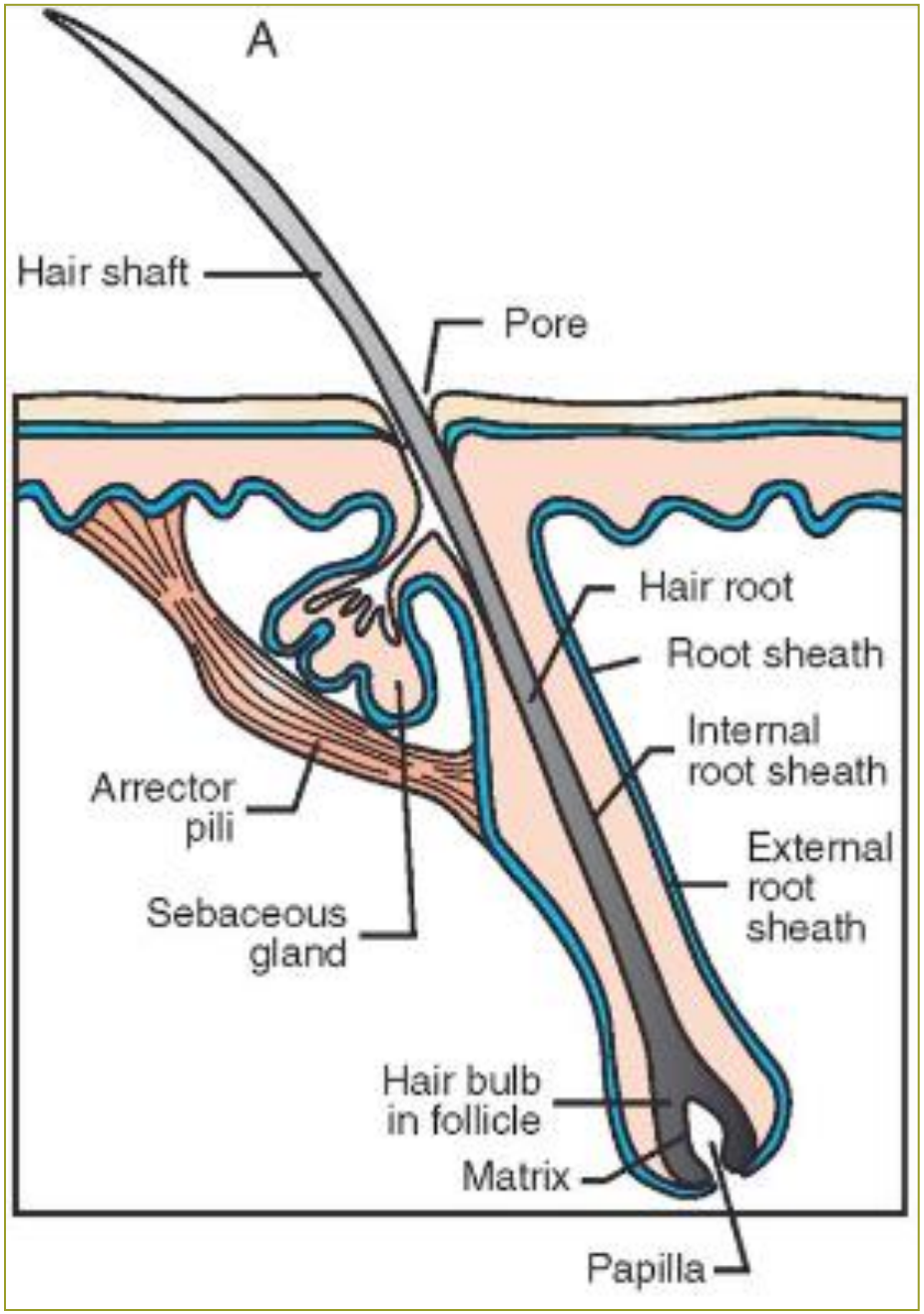
Figure 5-8, Page 141

- Infoldings of skin
- Infraorbital, interdigital, and inguinal pouches
- Contain fine hairs and numerous sebaceous and oil glands
- Secrete a fatty yellow substance which covers and sticks to the skin when dry



Topic 22

Discuss the adnexa (related structures) found in the integument



Related Structures of Integument

- Hair
  - Hair strands and follicles
  - Types of hair
- Glands of the skin
  - Sebaceous and sweat glands
  - Tail glands
  - Anal glands
- Claws and dewclaws
- Hoof
- Horns

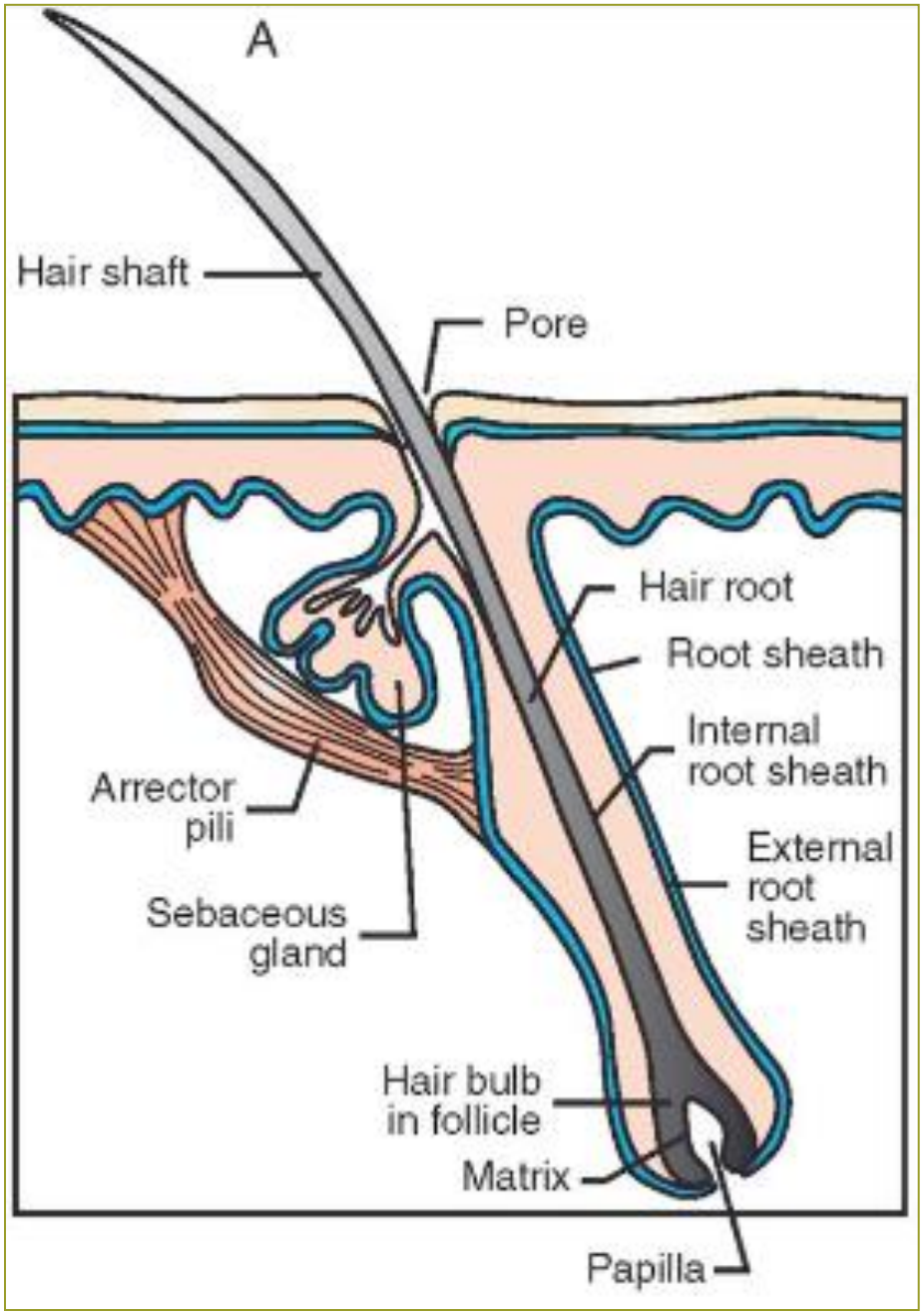
Hair

- Functions in maintaining body temperature; camouflage
- Thickens in cooler weather
  - More hair shafts per hair follicle

Hair

Figure 5-9A, Page 143

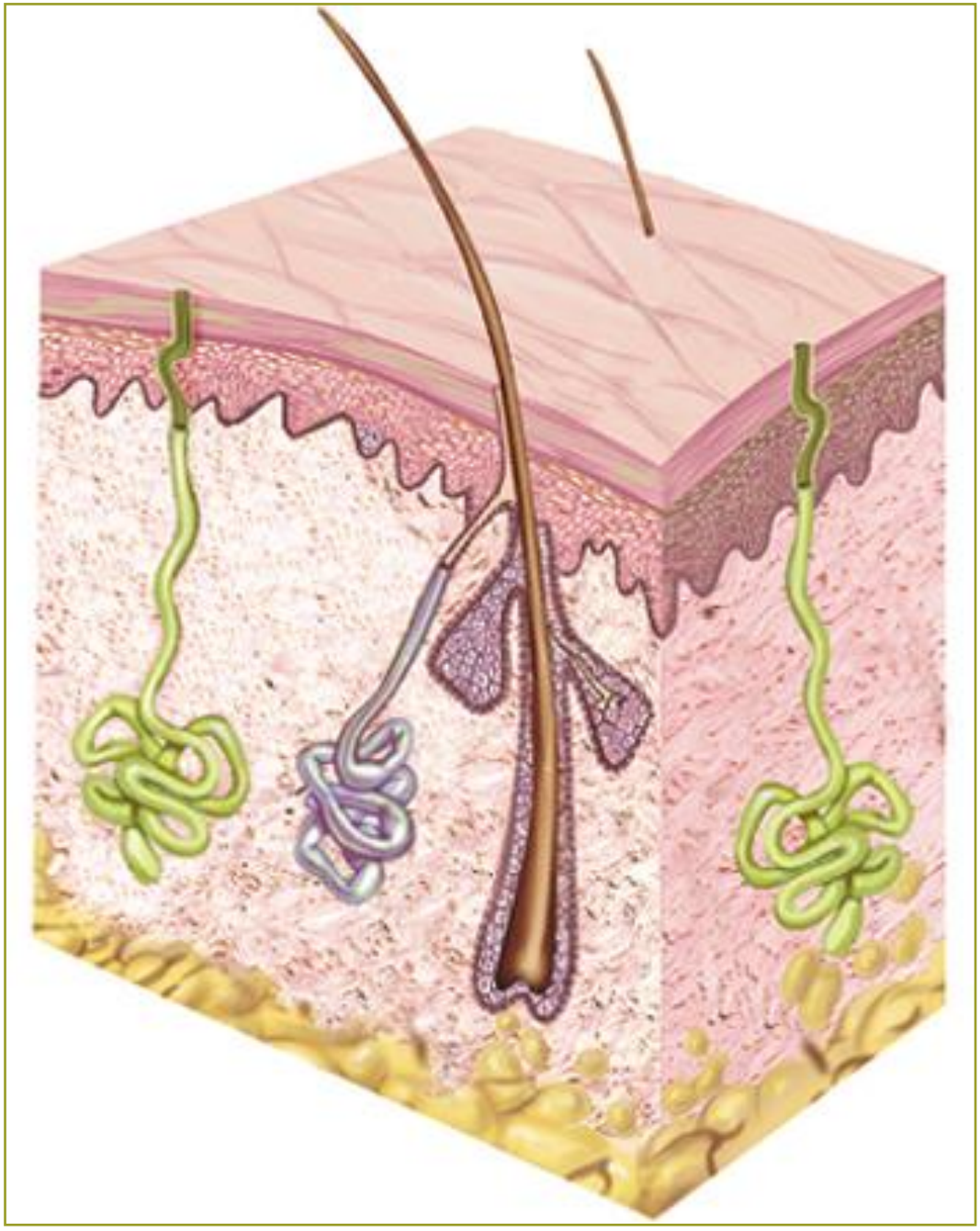
- Occurs as fur in most mammals
- Thickest on most exposed areas
- **Hair follicle**
  - Shaft
  - Pore
  - Root
  - Hair bulb
  - Dermal papilla
- Vibrissae

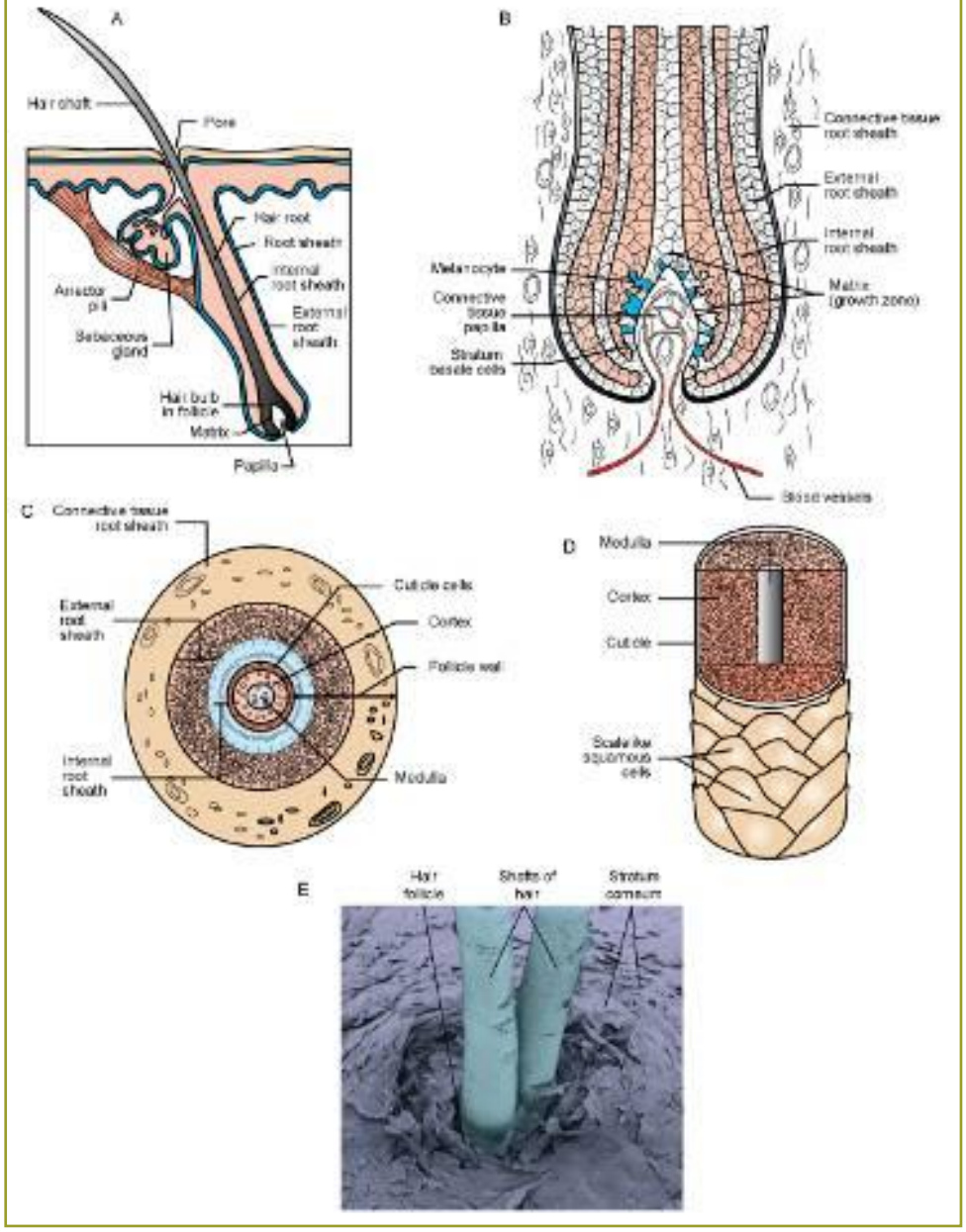


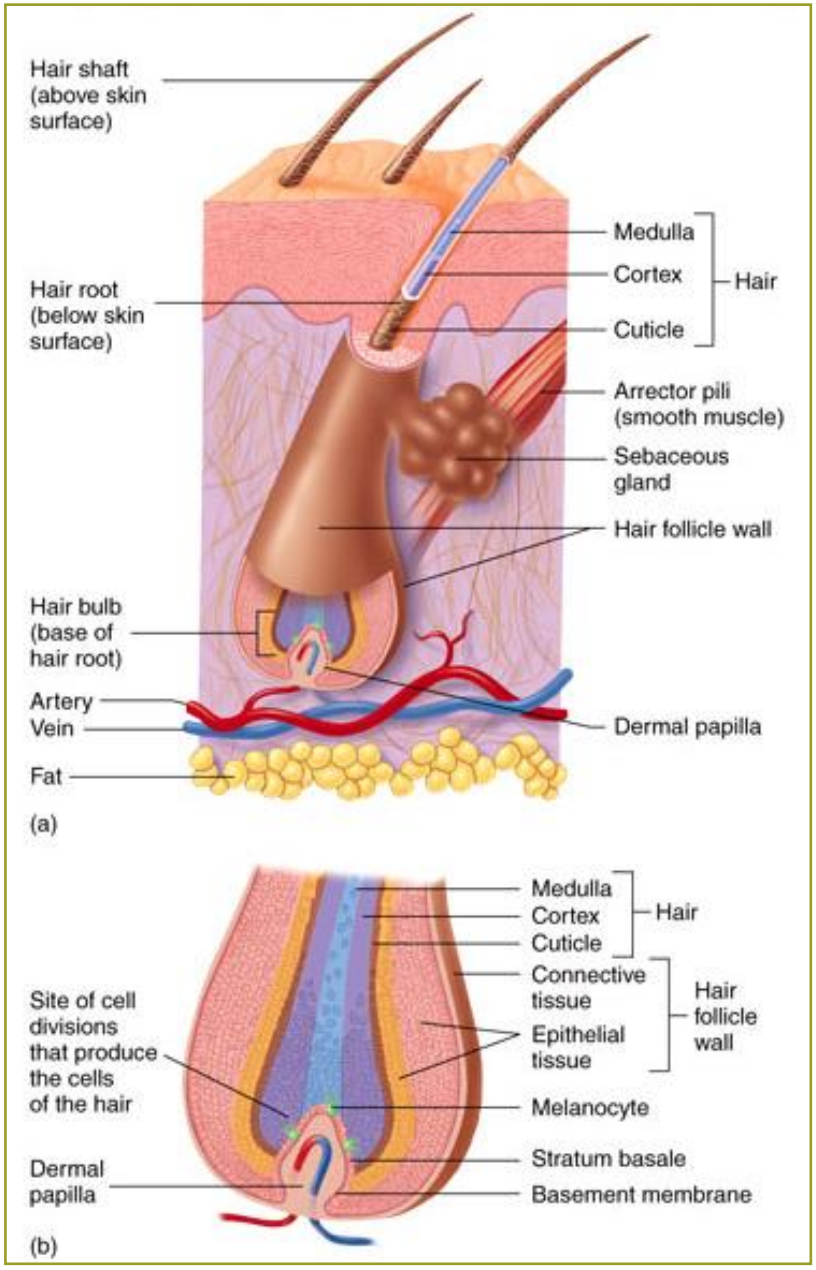
Hair Follicle Anatomy

Figure 5-9, Page 143

- Hair shaft: visible above the skin
- Hair root: buried within the skin
- Hair follicle: anchors the hair
  - Deepest part of hair follicle expands to form a hair bulb
  - At base of hair bulb is mound of dermal cells called papilla
  - Hair strands are formed as epithelial cells mature, fill with keratin, and move away from papilla
  - Root hair plexus: web of sensory nerve endings
    - Touch receptor




A
Hair shaft
Pore
Hair root
Root sheath
Internal root sheath
External root sheath
Arrector pili
Sebaceous gland
Hair bulb in follicle
Matrix
Papilla
B
Connective tissue root sheath
External root sheath
Internal root sheath
Melanocyte
Connective tissue papilla
Matrix (growth zone)
Stratum basale cells
Blood vessels
C
Connective tissue root sheath
Cuticle cells
External root sheath
Cortex
Follicle wall
Internal root sheath
Medulla
D
Medulla
Cortex
Cuticle
Scale-like squamous cells
E
Hair follicle
Shafts of hair
Stratum corneum


Hair shaft (above skin surface)
Hair root (below skin surface)
Medulla
Cortex
Cuticle
Hair
Arrector pili (smooth muscle)
Sebaceous gland
Hair follicle wall
Hair bulb (base of hair root)
Artery
Vein
Fat
Dermal papilla
(a)
Medulla
Cortex
Cuticle
Hair
Connective tissue
Epithelial tissue
Hair follicle wall
Site of cell divisions that produce the cells of the hair
Melanocyte
Stratum basale
Dermal papilla
Basement membrane
(b)

Hair Color

- Melanocytes at base of hair follicle
- Less melanin in older dogs (gray hair)
- White hair is formed when the cortex loses its pigment entirely and the medulla becomes completely filled with air

Hair Growth

- Hair growth – 0.18 mm per day
- Shedding
  - Genetics
    - “Groomer” dogs
  - Environment
    - Season change
    - Bitch after whelping

Hair Coat Length

- **Secret of Life!**
- Normal
  - Same as wild Canidae (German Shepard)
- Short
  - Boxers, Chihuahuas, Doberman Pinschers
- Long (often an “undercoat”)
  - Chow Chow, Malemute, Husky
- Seasonal changes – more hairs per follicle

Arrector Pili Muscles

- Small, smooth muscle attached to each hair follicle
- Innervated by **sympathetic** nervous system
  - **"Fight or flight"**
- Best erected on dorsal neck, back, & tail
- Not on vibrissae
- "**Goosebumps**" in people

Glands of the Skin

Sebaceous Glands

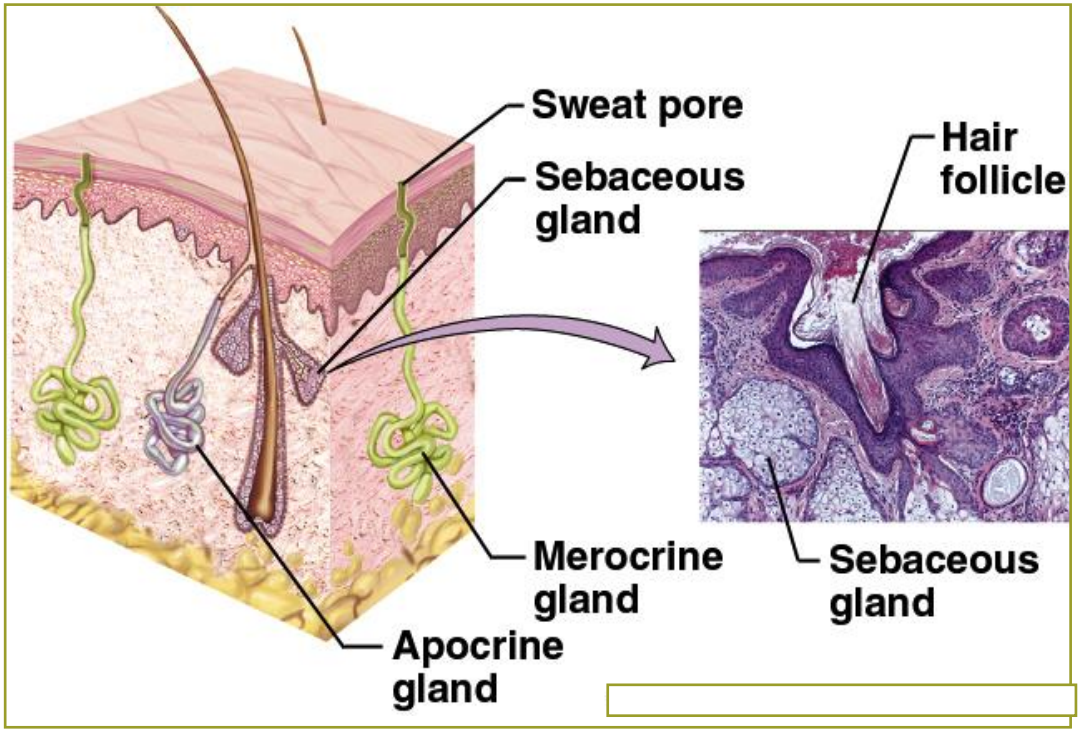
Sweat Glands (Sudoriferous Glands)

Tail Glands

Anal Sacs

Sebaceous Glands

- All over body in dermis except paw pads & planum nasale
- Duct empties into hair follicle
- Sebum – oily, lipid substance
  - Lanolin in sheep
- Sebaceous cysts
  - What dog breed?



Sebum

- **Arrector pili muscle** contracts and compresses sebaceous gland, forcing **sebum** through the duct into the hair follicle
- Coats the base of the hair and surrounding skin
  - Helps trap moisture, keeps hair soft, pliant, and somewhat waterproof
  - Sebum also helps reduce the skin's risk of infection

Sweat Glands

Figure 5-11, Page 146

- AKA "Sudoriferous Glands"
- Found over entire body of most domestic species
- Sweat helps cool animal body through evaporation
- 2 type of sweat glands
  - Eccrine – watery, found in footpads
  - Apocrine – thicker, smellier secretion
    - Found only with hairs

Sweat Glands

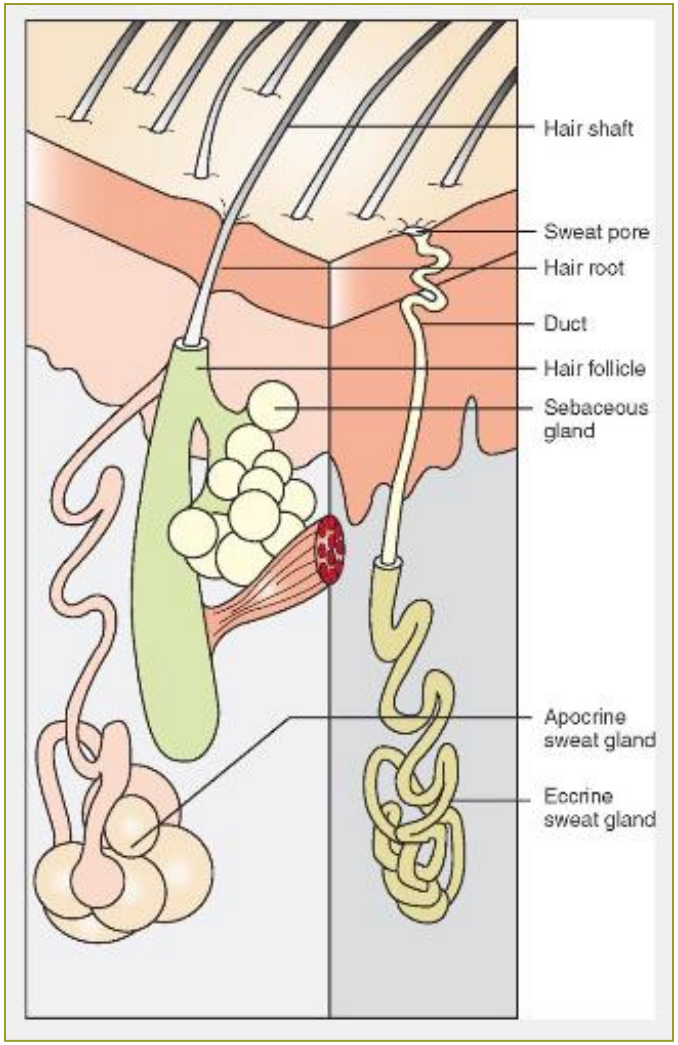
Figure 5-11, Page 146

Eccrine Sweat Glands:

- Excretory portion consists of a simple coiled tube located in the dermis or hypodermis
- Empty onto surface of skin through a long duct

Apocrine Sweat Glands:

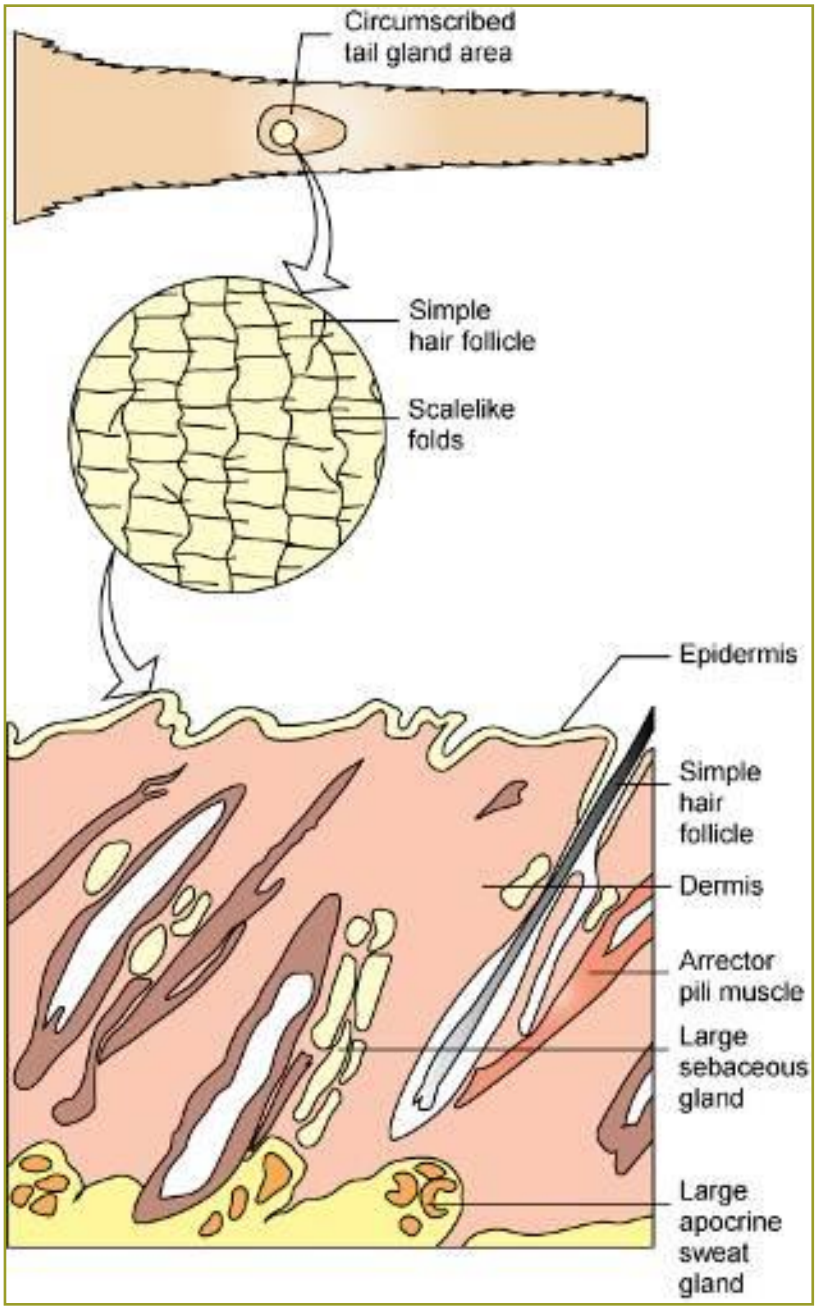
- Coiled excretory portion buried in the dermis or hypodermis; single excretory duct
- Empty into hair follicles



Tail Glands

Figure 5-12, Page 147

- **Oval region** at the dorsal base of the tails of most dogs and cats
- Contains **coarse, oily hairs**
- Very large apocrine and sebaceous glands present
- Thought to assist with recognition and identification of individual animals



Tail Glands

- Sex hormone influence?
- Wild Canidae a lot

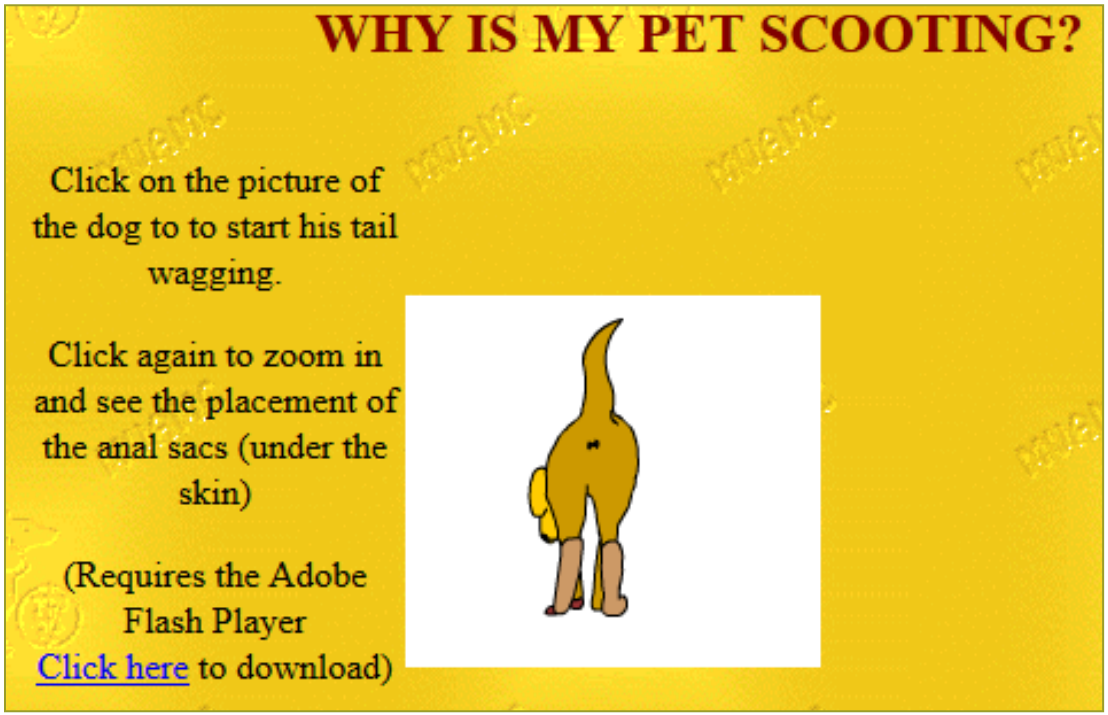
Anal Glands (Sacs)

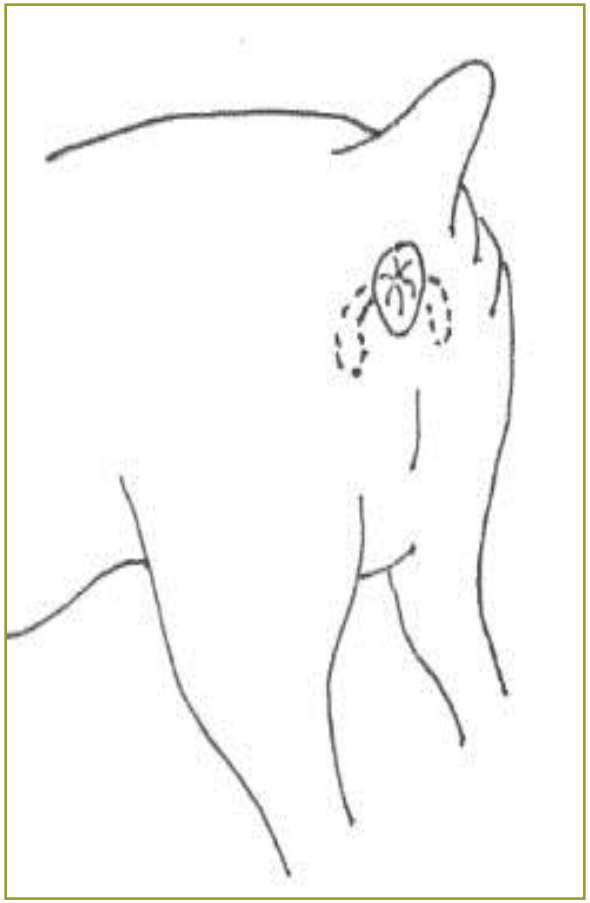
- Cats and dogs have anal sacs similar to musk glands of skunks
- Located at 4 and 8 o'clock positions relative to anus
- Connected to lateral margin of the anus by a small single duct
- When an animal defecates or becomes frightened, some or all of the anal sac contents are expressed

Anal Glands (Anal Sacs)

http://www.marvistavet.com/html/body_anal_sacs.html

- 4 & 8 o'clock





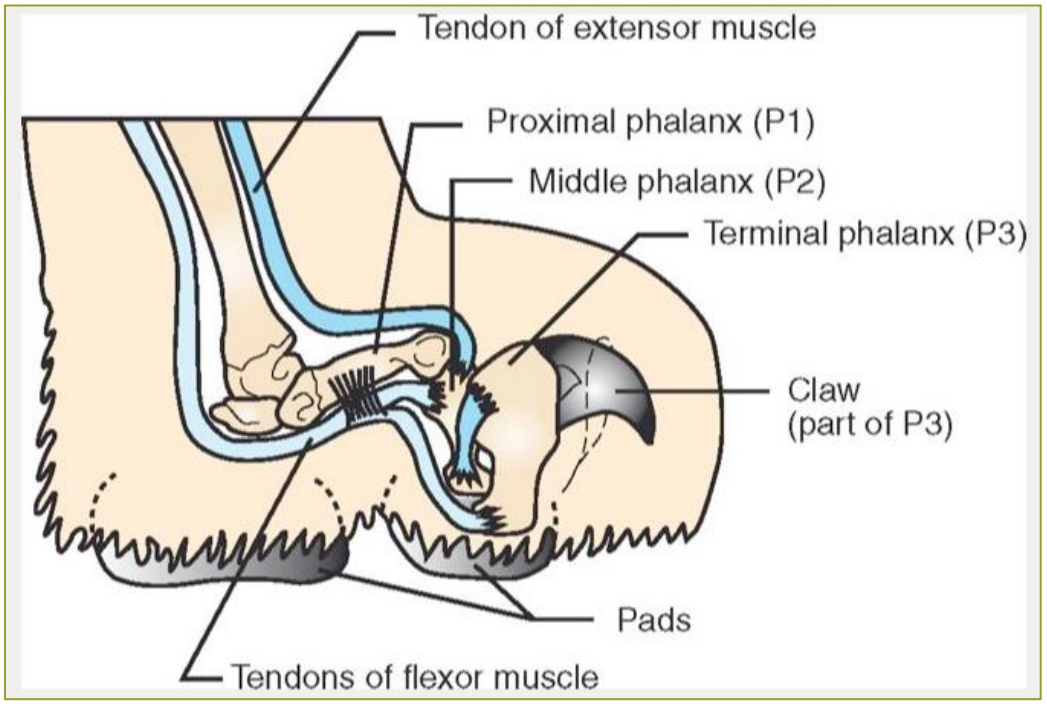
Claws, Nails, Hooves, Horns

From the Epidermis

Claws

Figure 5-13, Page 147

- Retractable or non-retractable
- Anatomy
  - Nail bed attached to distal phalanx (P3)



Claws and Dewclaws

Claws

- Hard outer coverings of the distal digits
- Usually pigmented
- Function in maintaining traction and serve as tools for defense and catching prey
- Claws are non-retractable except in most cat species

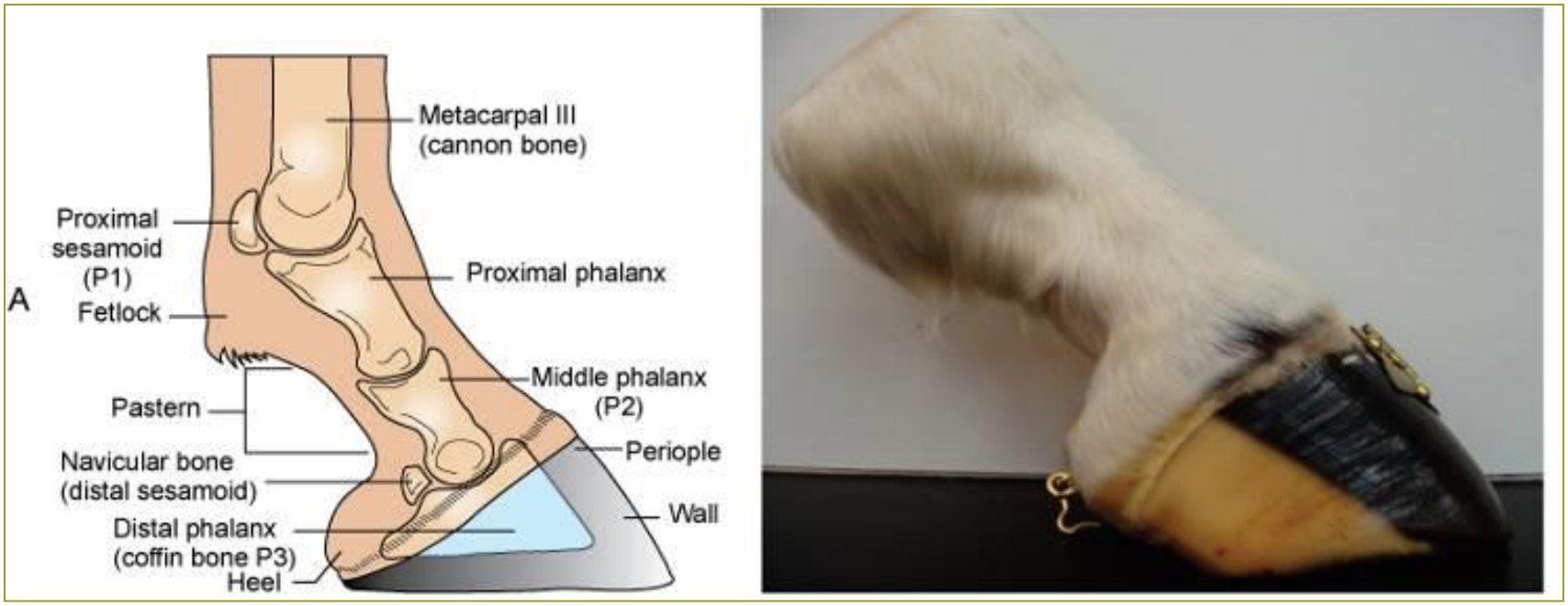
Dewclaws

- Evolutionary remnants of digits
- In the dog, the dewclaw is the first digit
- In the cow, pig, and sheep, the medial and lateral dewclaws are the second and fifth digits, respectively

Hoof

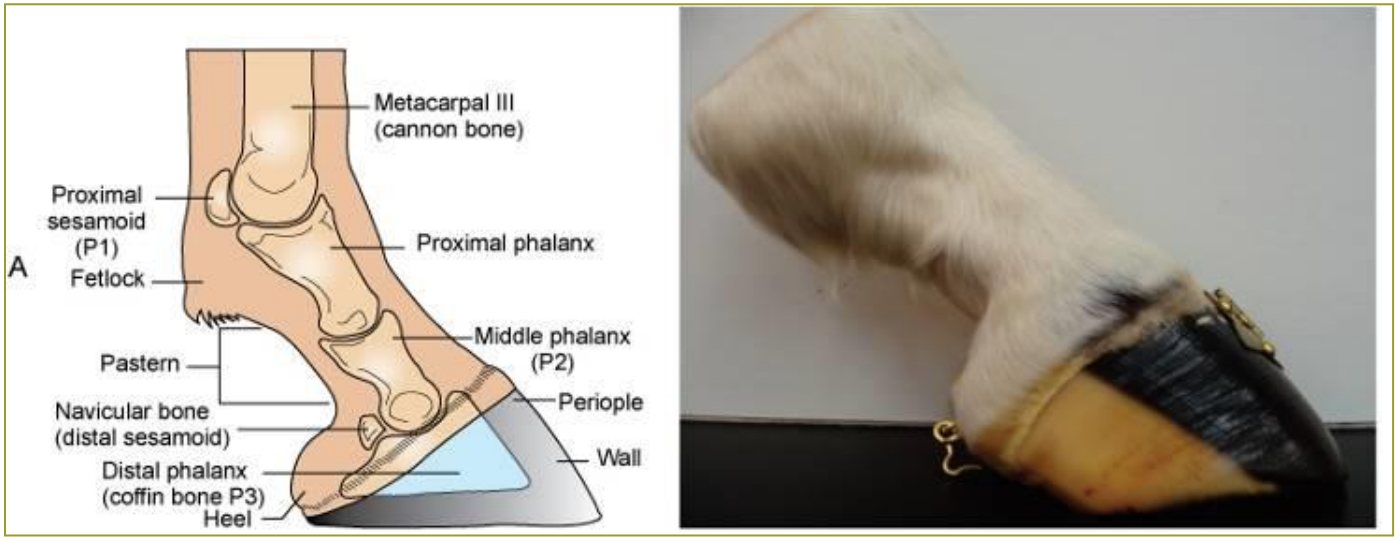
Figure 5-14, Page 148

- Horny outer covering of digits of some animals
- Another name for “hoof” is *ungula*
  - Hoofed animals are called *ungulates*



Hoof

- The skeletal foot of horse includes
  - Distal part of the second phalanx
  - Distal sesamoid bone (navicular bone)
  - Entire third phalanx (coffin bone).
- The equine hoof is generally divided into three parts: the wall, the sole, and the frog



Hoof

The wall:

- External portion of the hoof

The sole:

- Plantar, or palmar, surface of the hoof; outer layers are avascular and lack innervation

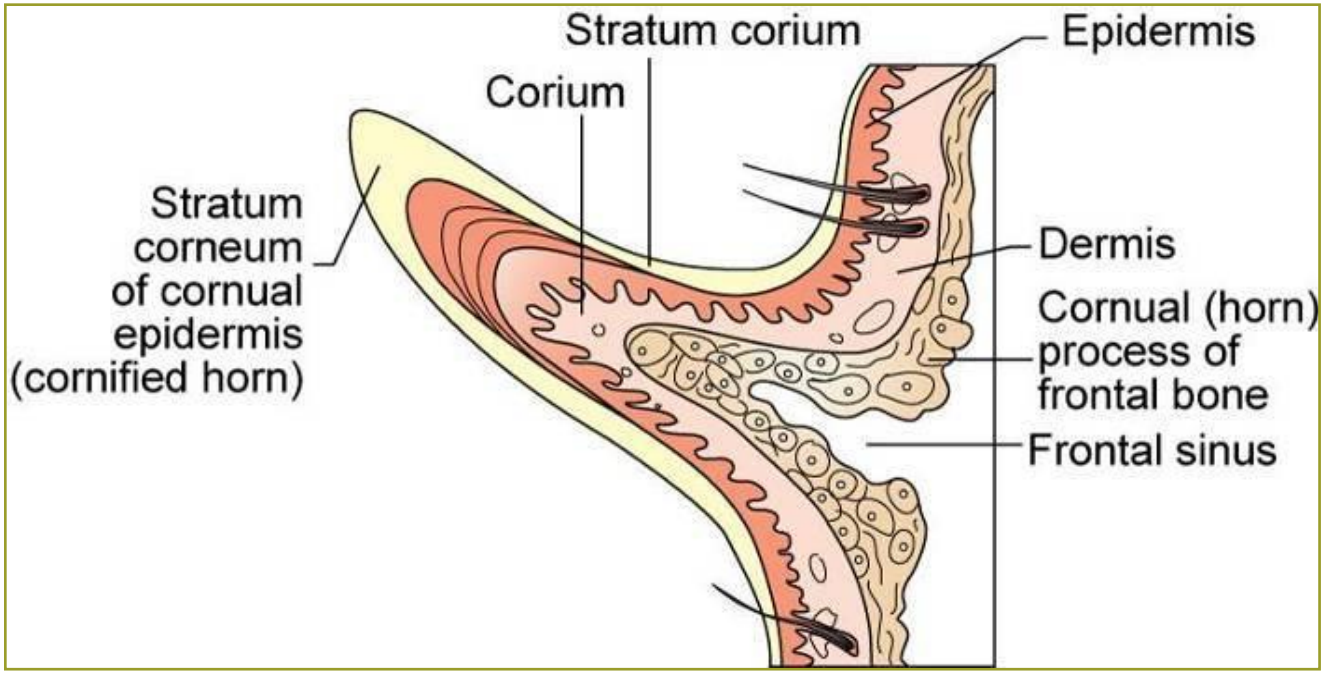
The frog:

- Triangular horny structure located between the heels on the underside of the hoof

Horns

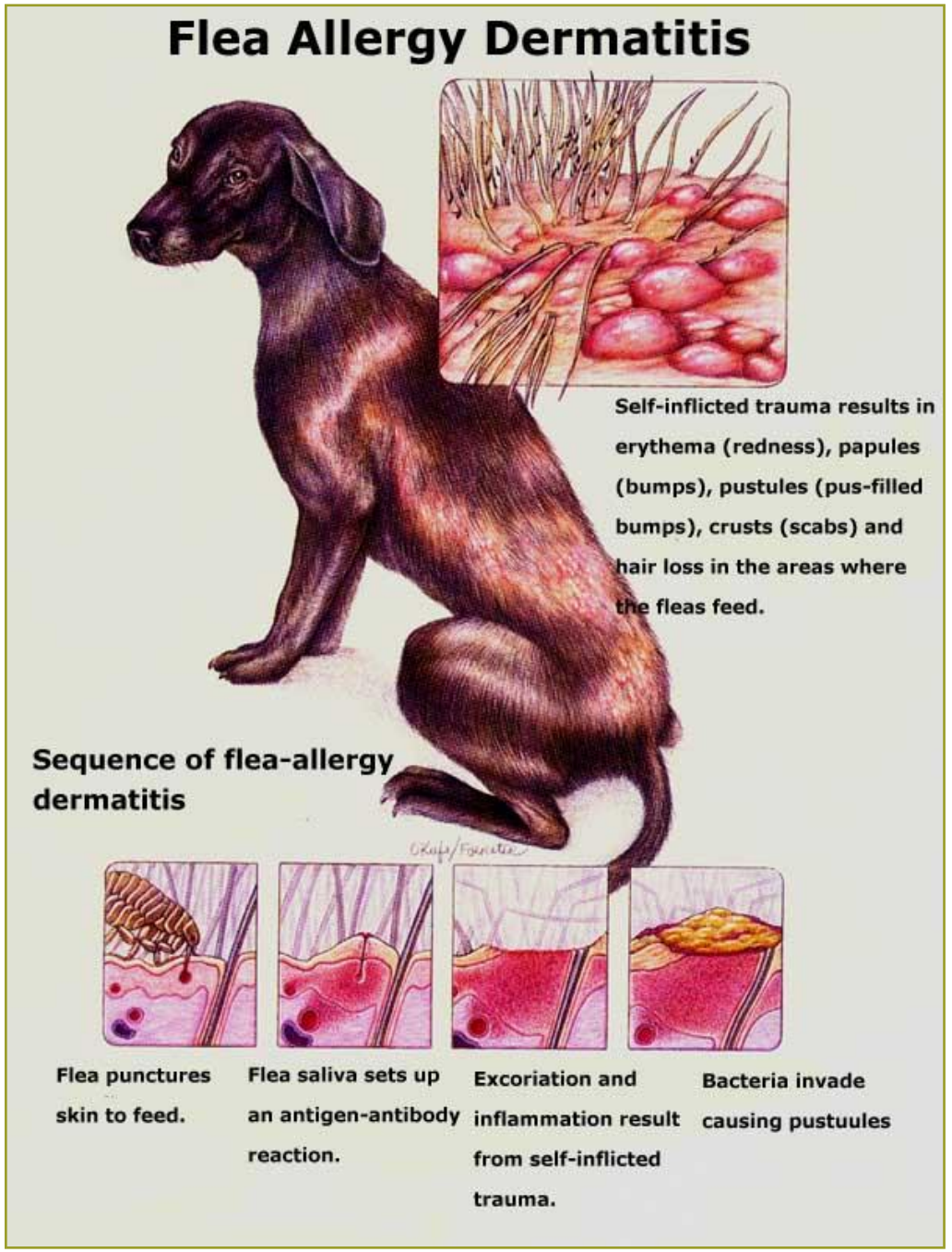
Figure 5-19, Page 150

- Epidermal in origin
- Structurally similar to hair
- Composed of keratin



Topic 23

Discuss some of the skin pathology commonly seen in veterinary practice

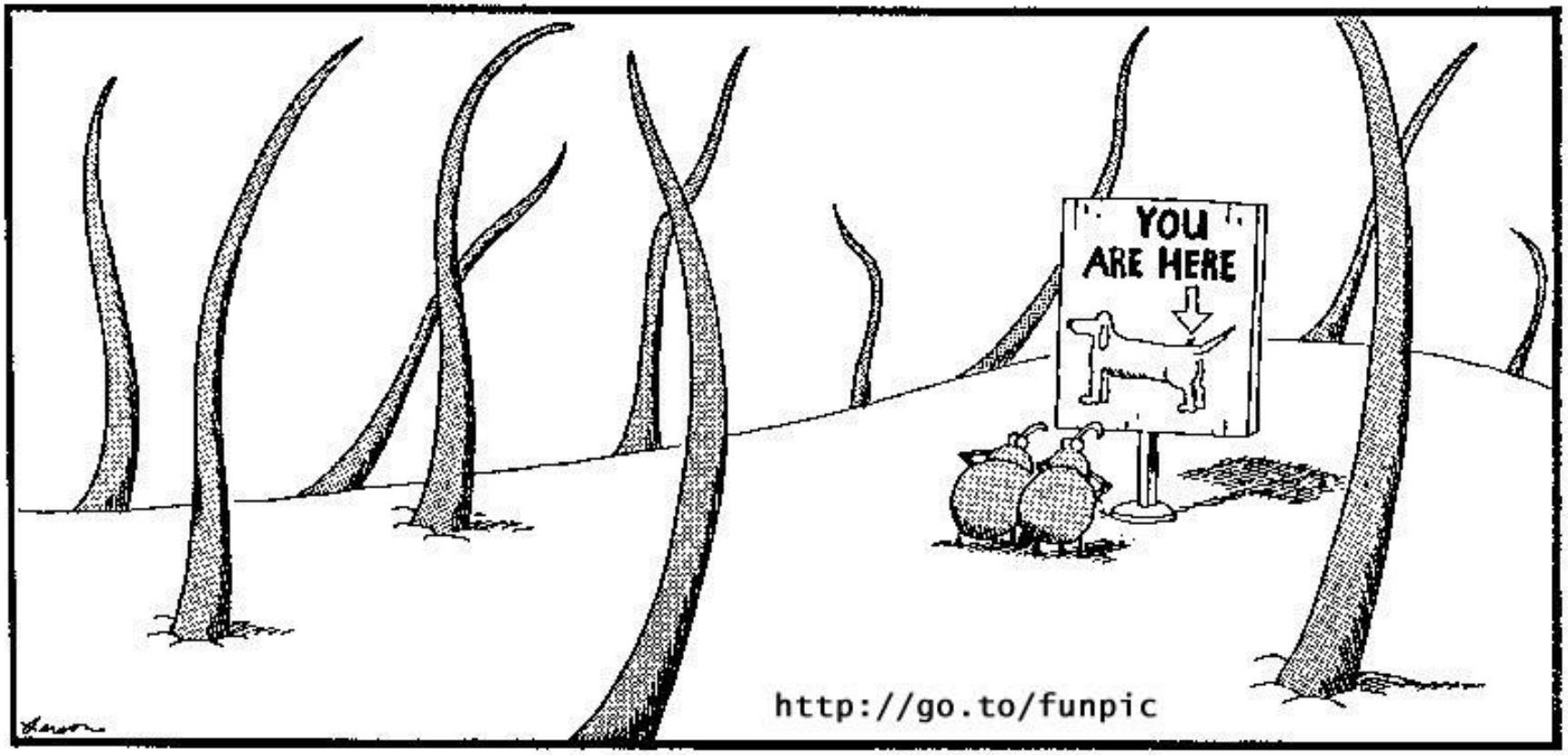


Common Skin Pathology

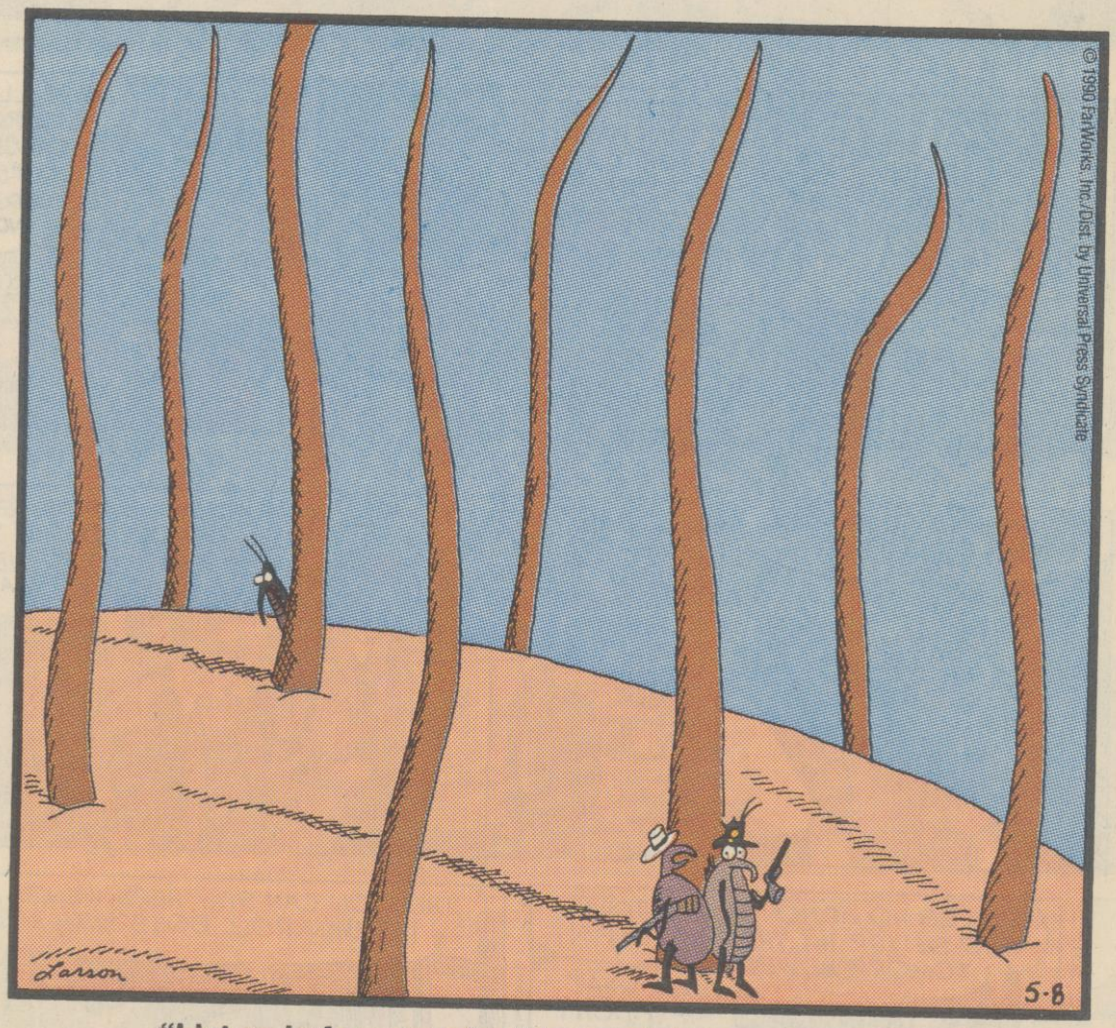
- Dermatitis
- Alopecia
- Pruritis
- “Hot spots”
- Seborrhea
- Ectoparasites
  - Fleas
  - Mites

Alopecia? ☺

Fleas!

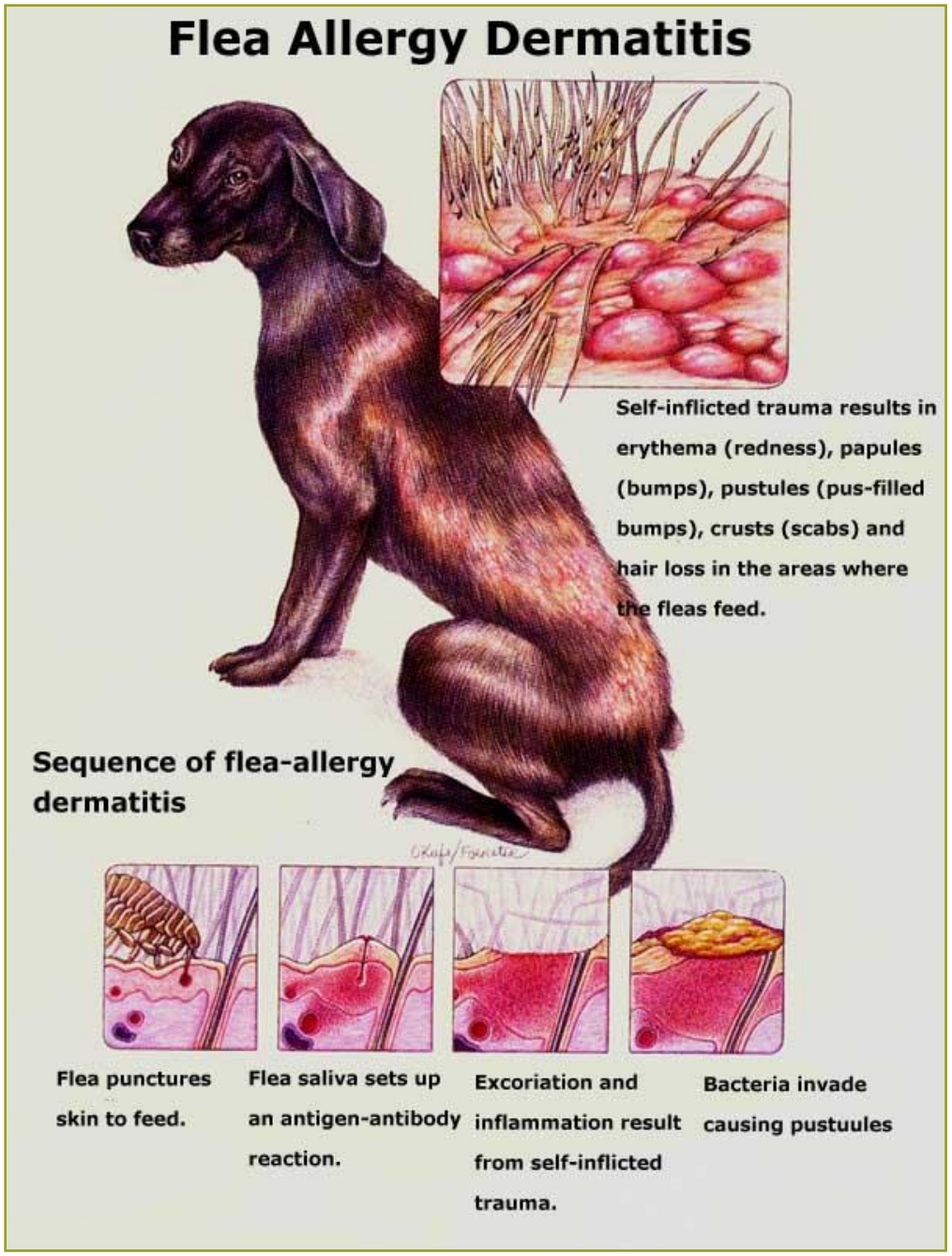


THE FAR SIDE BY GARY LARSON



"Listen, before we take this guy, let me ask you this:
You ever kill a flea before, Dawkins? It ain't easy."

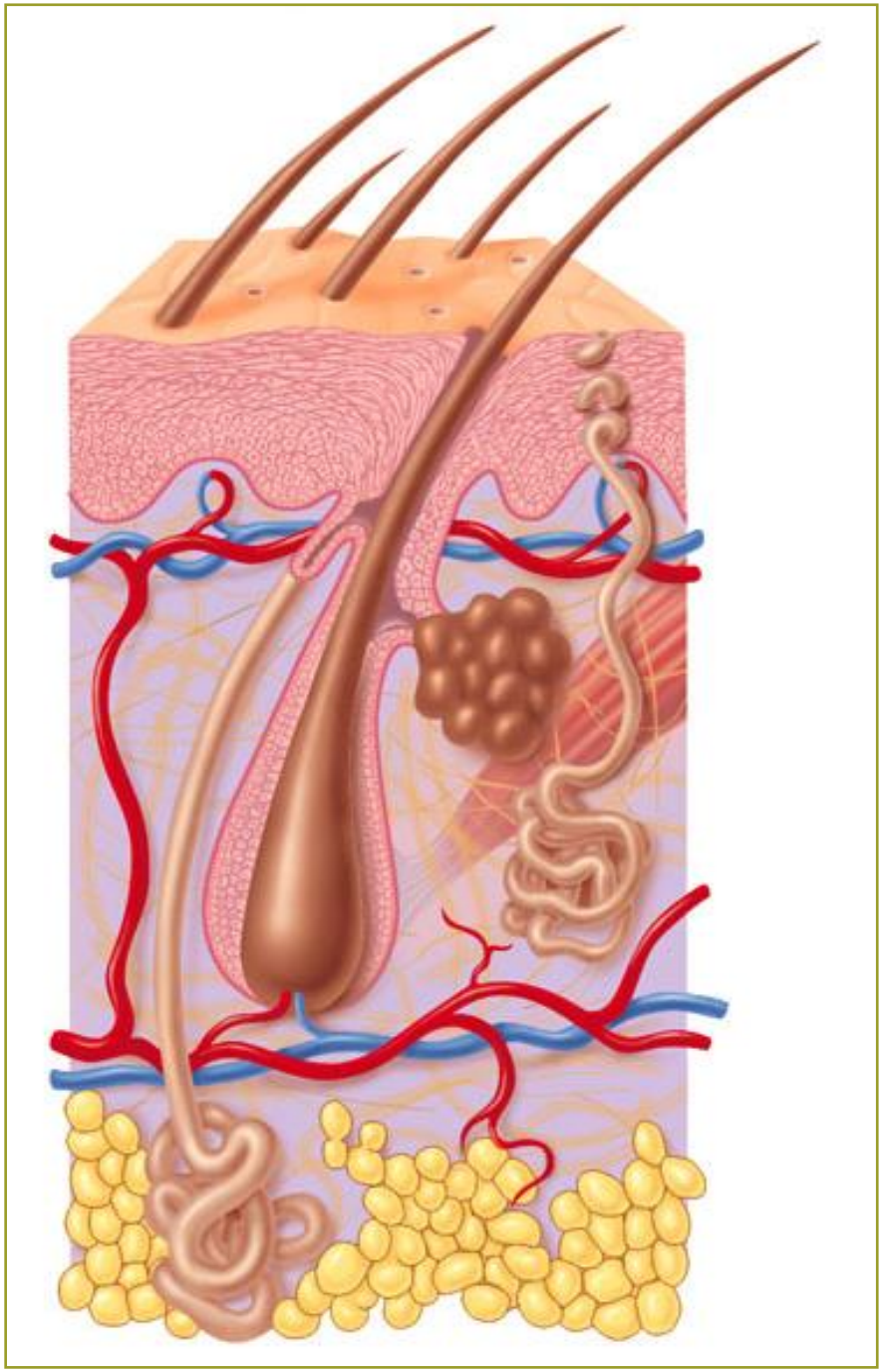
Flea Allergy Dermatitis (FAD)



Clinical Applications

- Skin Cancer (Page 133)
- Allergies: Itchy Business (Page 145)
- Laminitis: A Painful Health Risk to Horses (Page 152)

Review of the Skin



Test Yourself

KNOW THESE IN EVERY CHAPTER!

Pages 138, 139, 145, 147

Clinical Applications

Pages 133, 136-137, 138, 145, 152