Basic Skin Structure and Function

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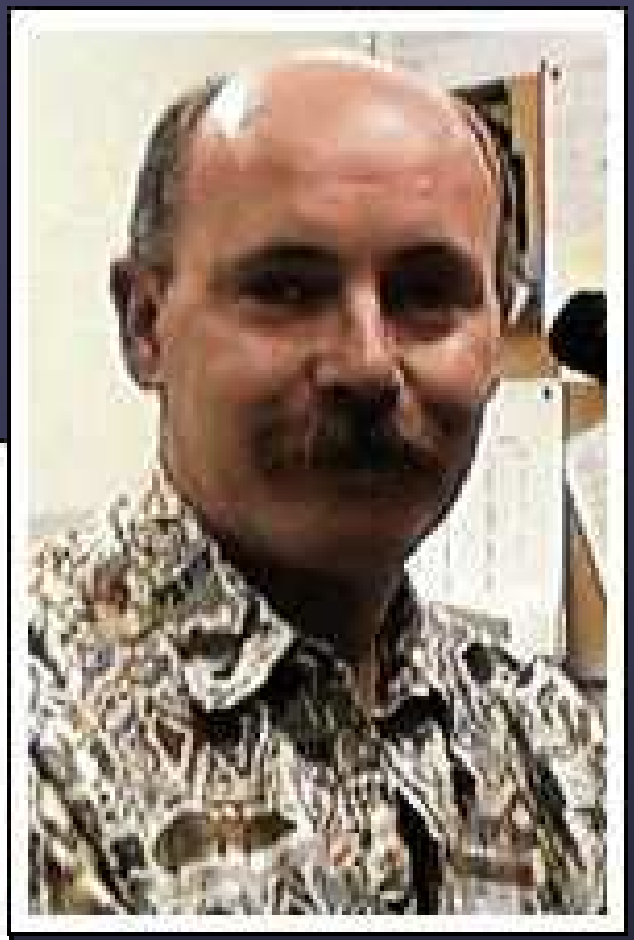
- The International Society of Veterinary Dermatopathology encourages your membership. Please see www.isvd.org for more information

New Bolton Center

- 950 large animal necropsies per year
- 425 LA biopsies.

Philadelphia

- 22,000 outside biopsies
- 450 SA/Exotics necropsies




The Pennsylvania Gazette

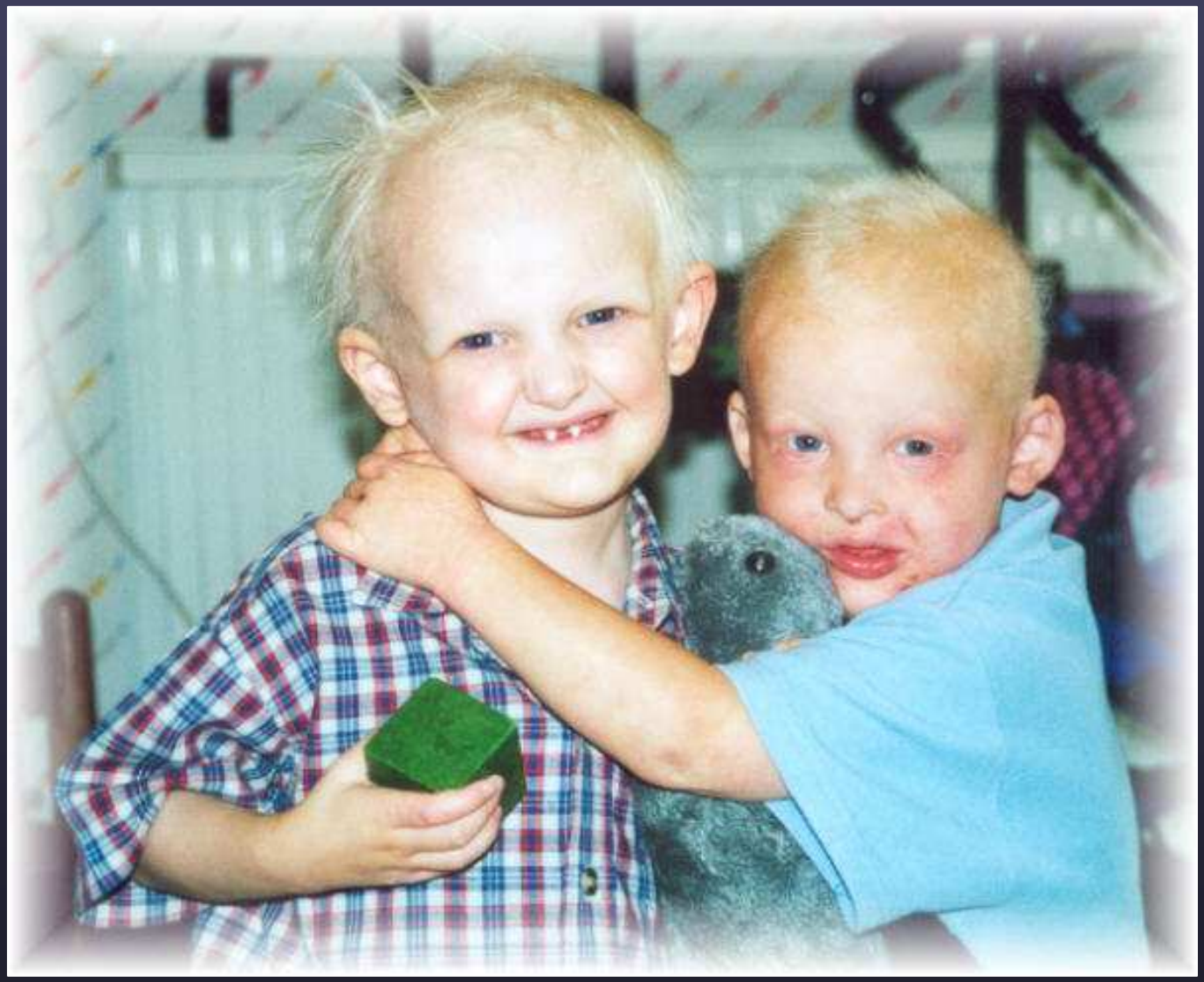
Clinical Departments

- Matthew J. Ryan Veterinary Hospital-Philadelphia
    - 28,000 patient visits/year
- Widener Hospital for Large Animals
    - 10,000 patient visits/year + field service

Dr. Margret Casal

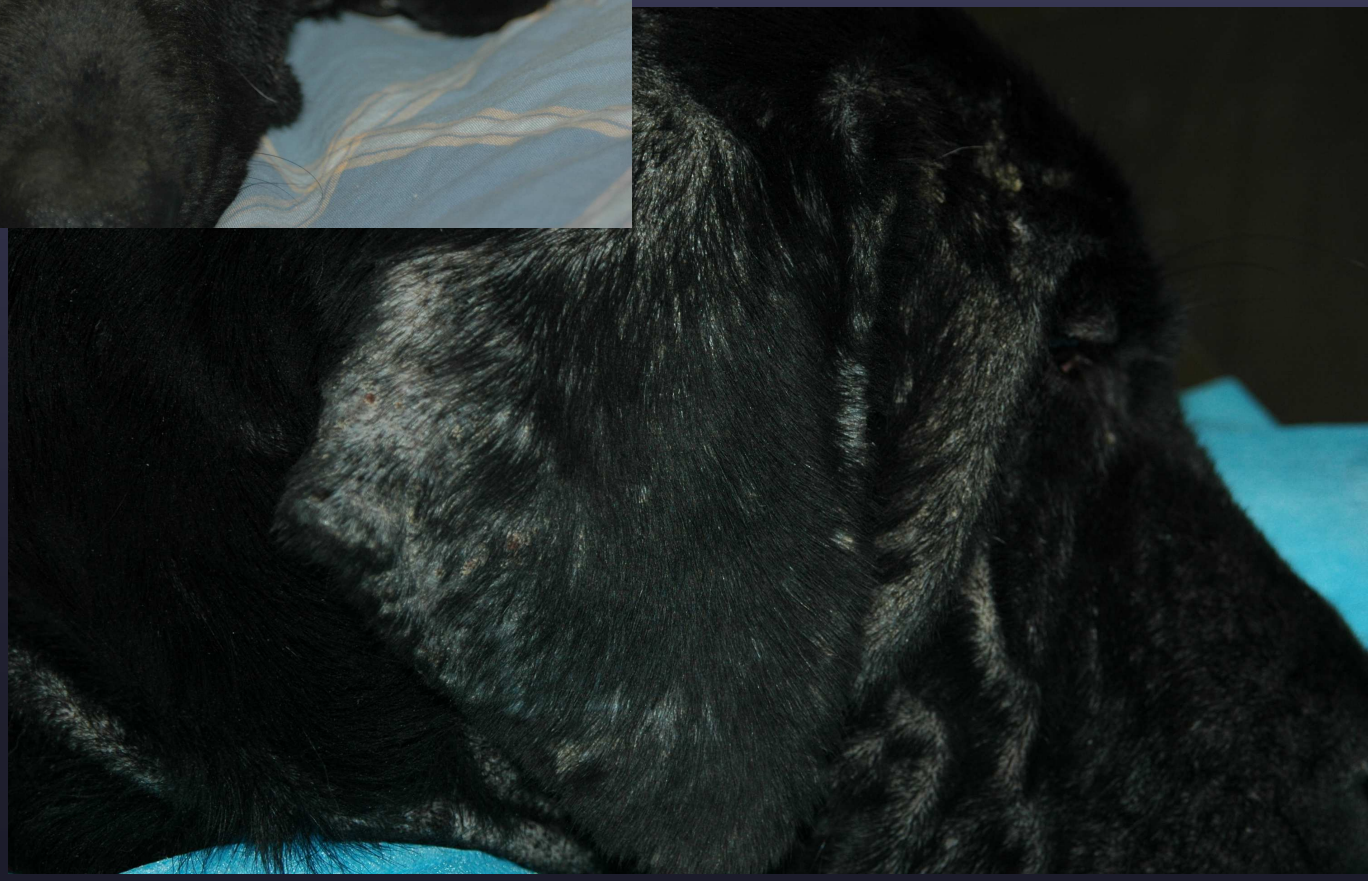
Hypohidrotic Ectodermal Dysplasia

- Initial dog with Hypohidrotic ectodermal dysplasi



Ehlers-Danlos in Labradors

Lupoid derm of GSP



Congenital Follicular Parakeratosis

- Congenital follicular parakeratosis

Outline- Day 1

- Basics of skin biology and cornification
- Teaching your clients to submit proper samples
- Practical dermatopathology

  How to use pattern diagnosis correctly
- Interface disorders: Concepts and Controversies

Day 2

- Journey into the hair follicle and follicular diseases
- What's new in Equine Dermatopathology?
- Miscellaneous disorders
- Master class- "nuts and bolts" of daily dermpath in 1 ½ palates

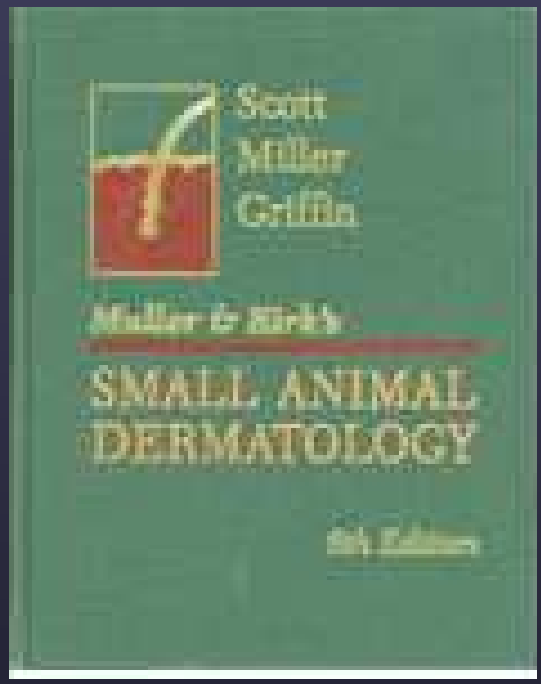
Reasons for Vet Visit

1. **Ear Infection**
2. **Skin Allergy**
3. Stomach upset
4. **Benign tumors**
5. Bladder infection
6. **Skin infection**

- 2005, Veterinary Pet Insurance Co.

Difficulties in Dermpath

- *Many* veterinary dermatologic diseases/syndromes to know
- Few have been thoroughly investigated
- Skin biopsies are tedious
- Histopath + clinical presentation often *key* to correct diagnosis
- Pathologist must have good clinical background
- Pathologist relies on clinician to select appropriate sample

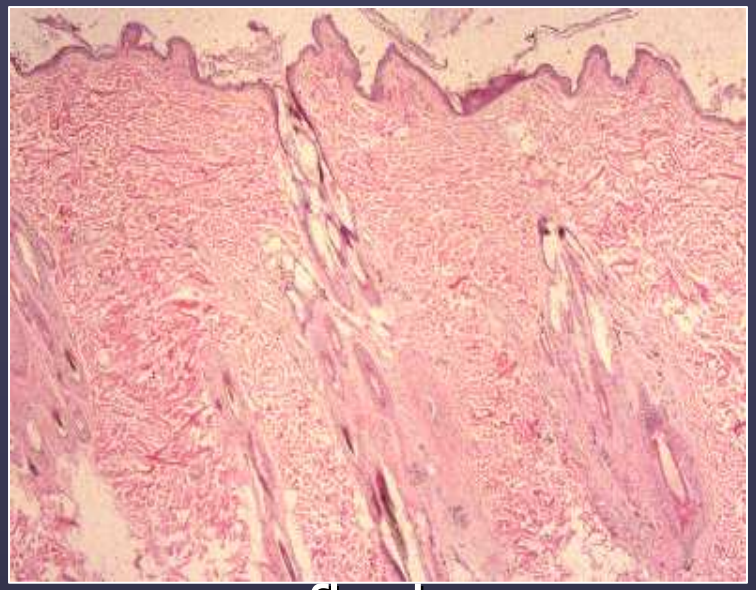


- Metatarsal fistulas of German shepherd dog

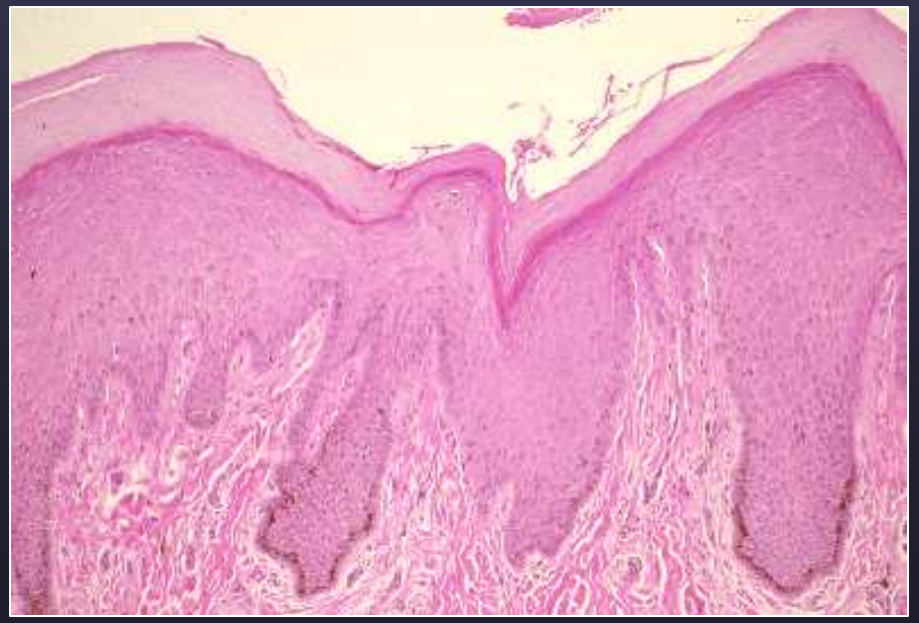
- Use the derm vocabulary
- Know the gross lesions associated with skin disorders

- Teaching dermpath to students
  - Stress Function
  - Consequences of Function Loss (Dysfunction)

- footpad

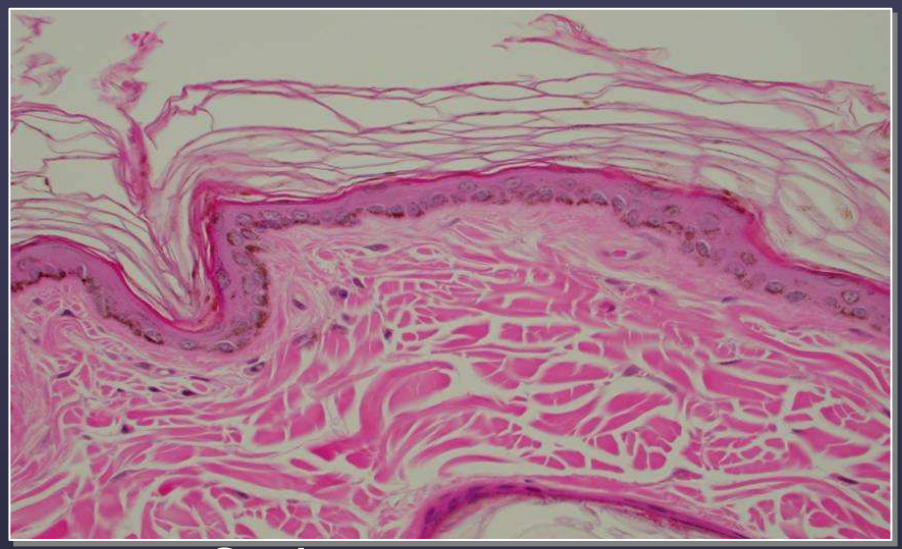


- flank



- nasal planum

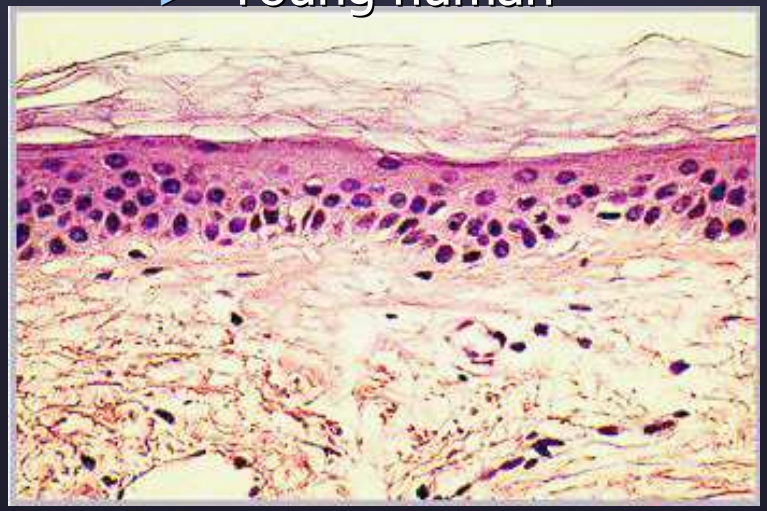
Species Differences



- Canine

- Young human

- Swine



- Aged human

Structure/function and dysfunction

- Barrier function
- Disorders of cornification

Functions of Skin

- **Indicator of general health and disease**

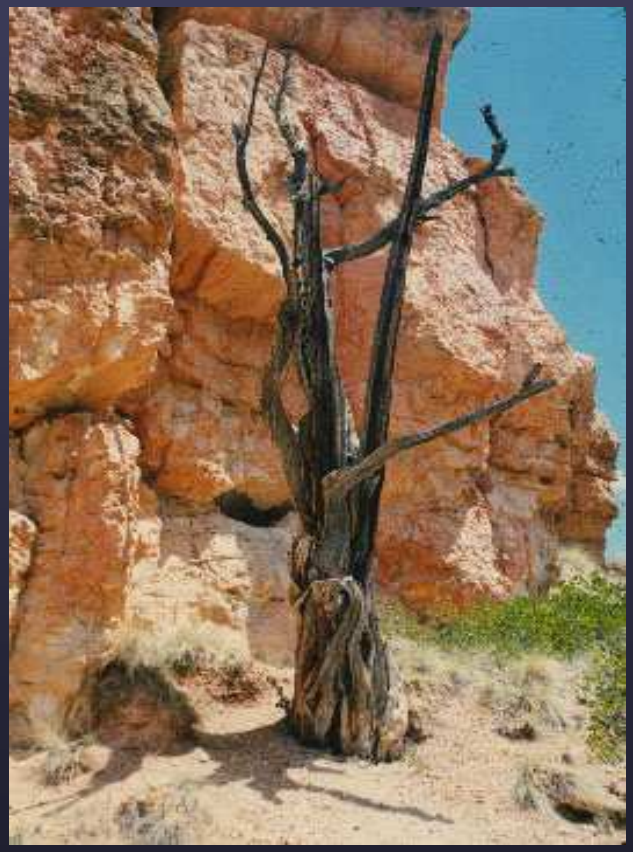
Enclosing Barrier

- #1 PREVENT WATER LOSS
- Prevent loss of ELECTOLYTES
- Prevent loss of Cells
- PROTECT from environmental insults
  - Microbial
  - Thermal
  - Chemical

Keep Pathogens OUT
Keep Moisture and Nutrients IN

Protect from Environmental Insults

- **Photoprotection**
  - **Pigmentation (melanocytes)**
  - **Hair**



Barrier Function

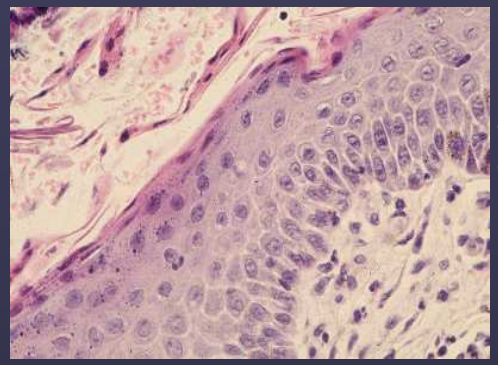
- Continuous desquamation
- Structural integrity
- Skin Immune System
  - Keratinocytes
  - Langerhans cells
  - dermal dendritic cells + lymphocytes

  → constant immunosurveillance

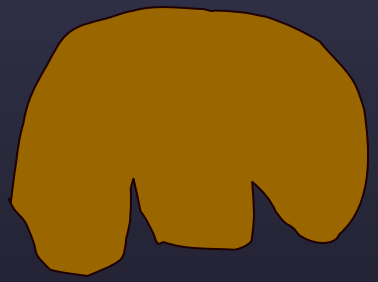
Functions of Skin

- Sensory Organ
  - touch, heat, pain, cold, itch
- Temperature regulation
  - Equine Anhidrosis
- Storage of electrolytes, fat, protein

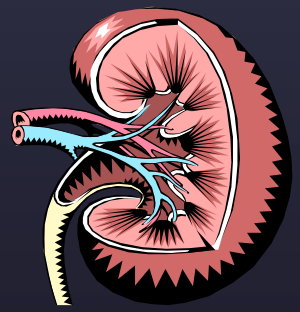
Produce Vitamin D



Epidermis converts proVitD3 into VitD3



Vit D3 hydroxylated in Liver to 25, Vit D3



Converted to active form 1,25 Vit D3

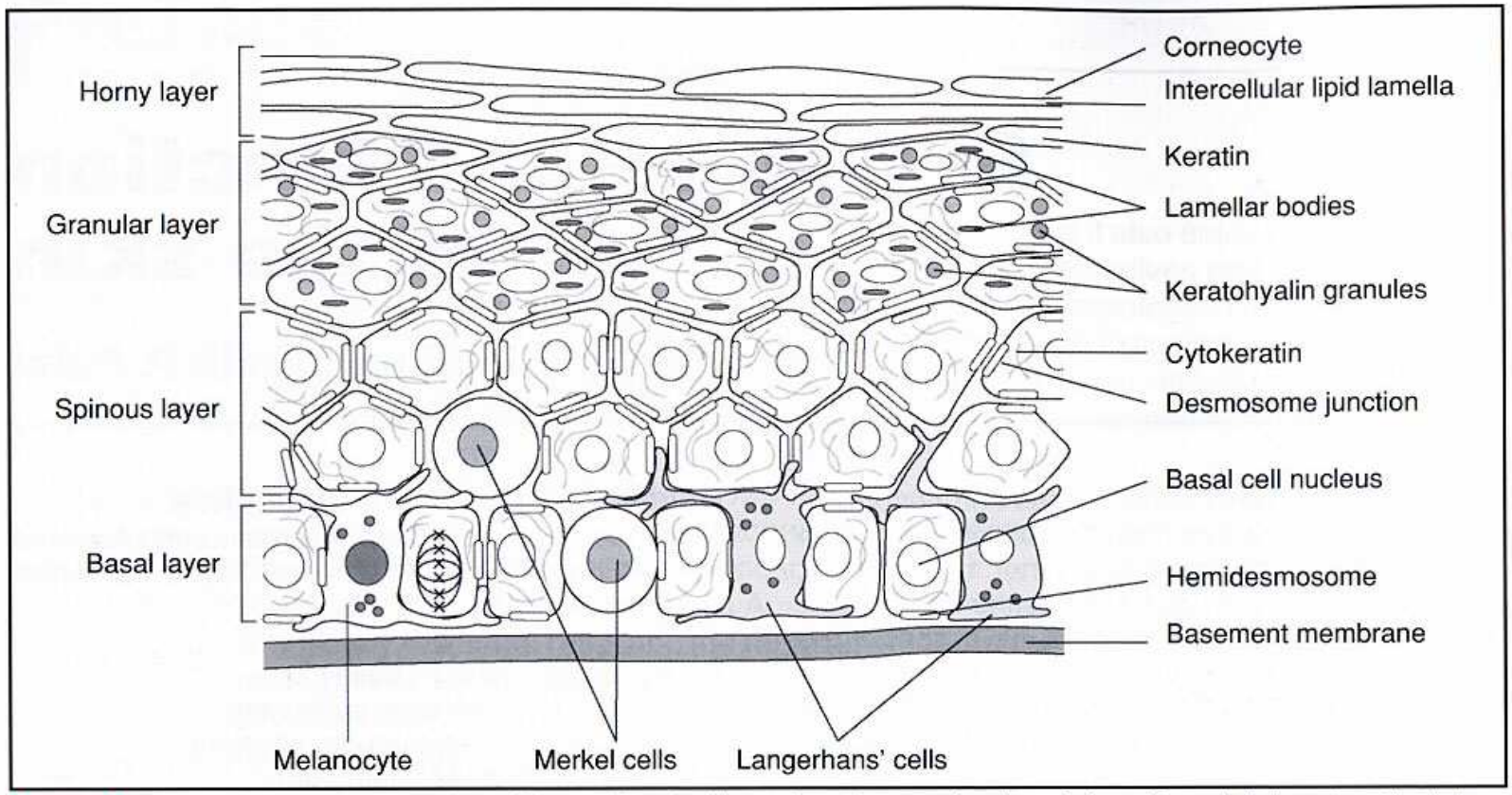
Vitamin D3 and the Skin

- **Regulating epidermal differentiation**
- **Epidermal proliferation**
- ***Topical** Vit D synthetic analogs for treatment of psoriasis*

Components of the Skin

- **Epidermis**
- **Basement membrane zone**
- **Dermis**
- **Adnexal structures**
  - hair follicles, apocrine glands (epitrichial), eccrine glands (atrichial), sebaceous glands, arrector pili muscles
- **Subcutis** (hypodermis)
  - No subcutis in some areas (cheek, eyelid, anus, external ear)

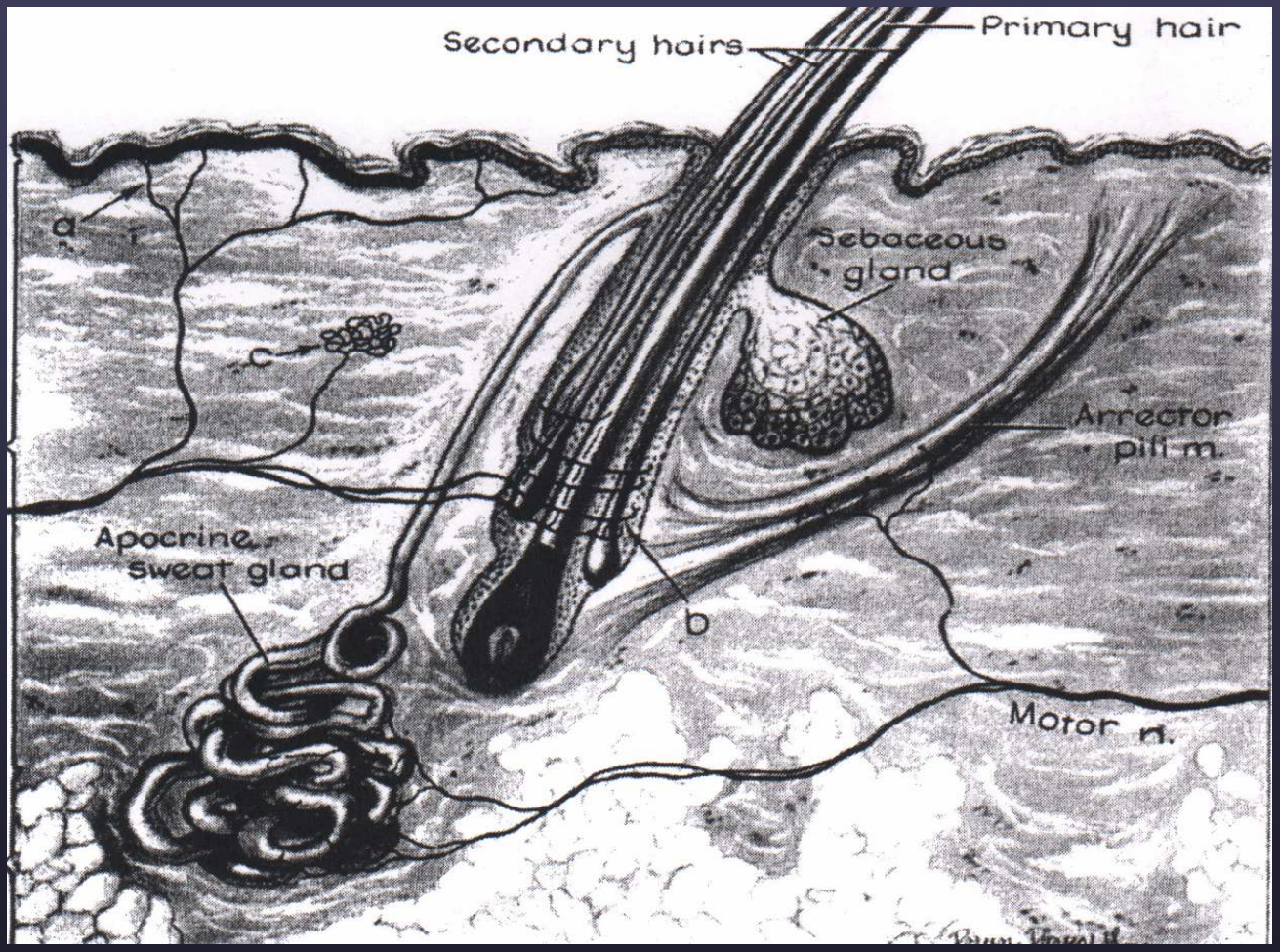
Chapter 1 Structure and function of the skin



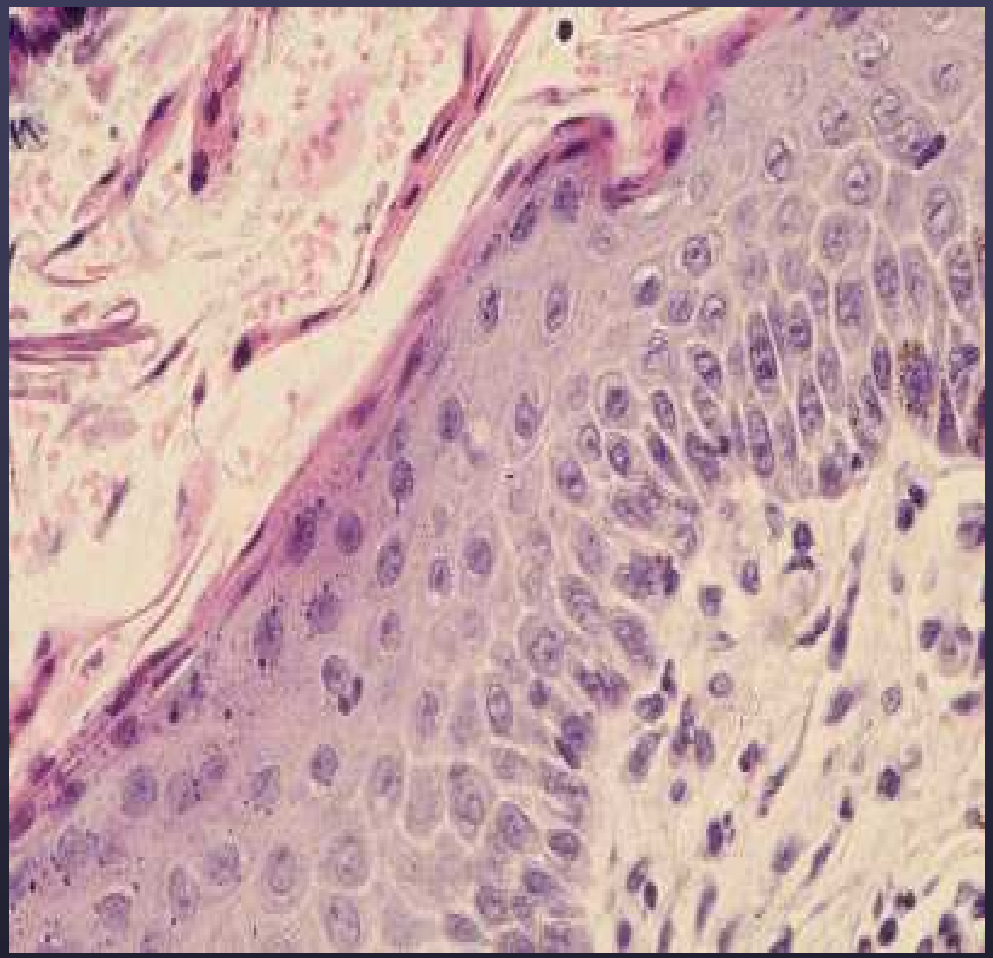
1.2 Diagrammatic representation of the epidermis, illustrating the organization of the cells and their maturation into fully cornified cells. © Anita Patel.

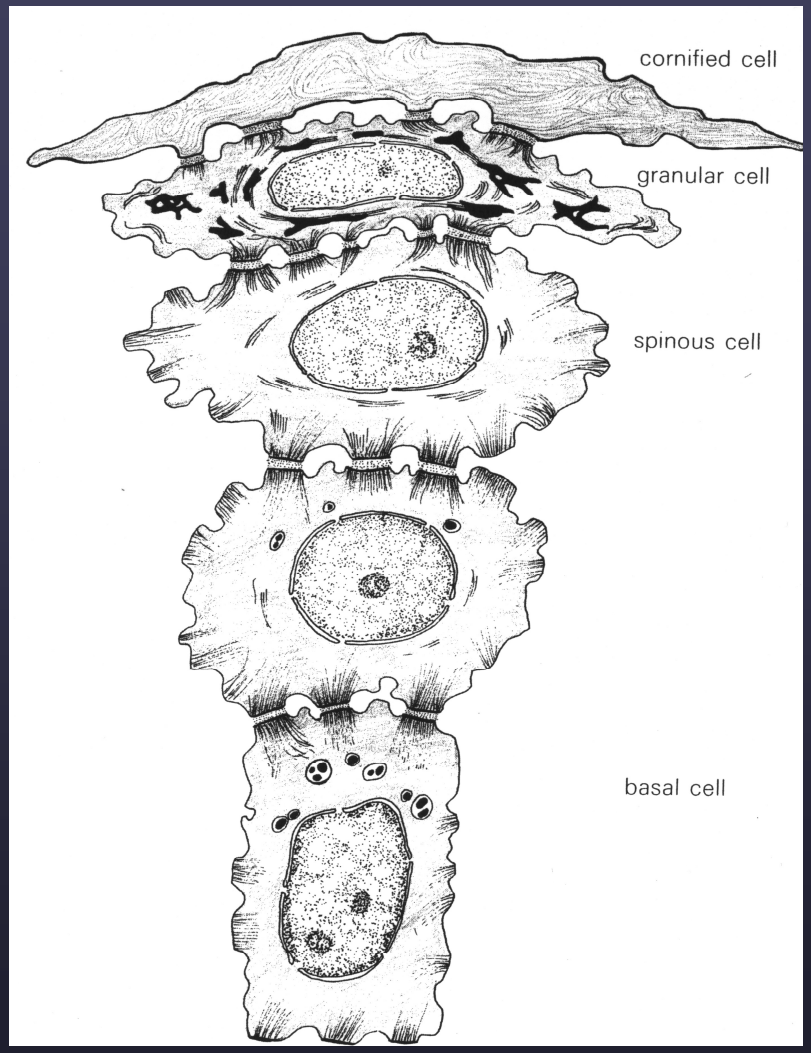
- BSAVA Manual of Small Animal Derm, 2003

Normal Anatomy of the Dog



- Muller and Kirk's Small Animal Derm, 2001





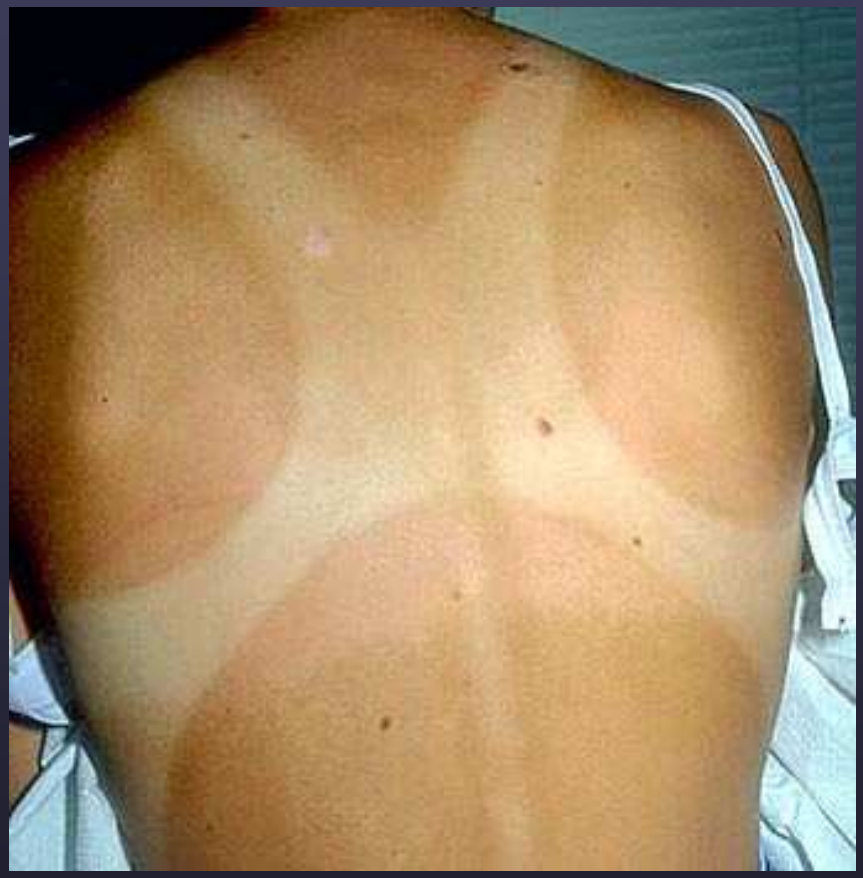
- Ackerman's Histologic Diagnosis of Inflammatory skin diseases, 1978

Functions of Keratinocytes

- Structural support
- Contribute to skin immune system
- Undergo differentiation and cornification→ major barrier function

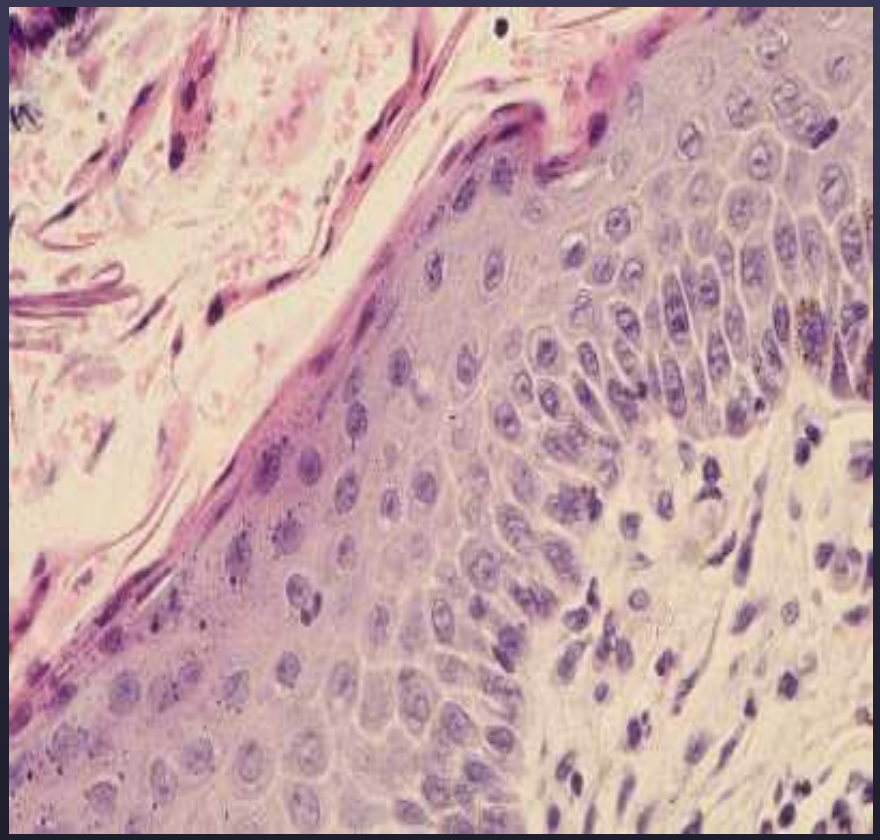
Keratinocytes and Inflammation

- Produce cytokines
  - Constitutively
  - Upon activation
  - Can cause systemic effects
  - Produce other inflammatory mediators
    - Neuropeptides, free radicals, prostaglandins, growth factors
- Drug metabolism



Keratinocyte Differentiation and Cornification

- Modified form of apoptosis
- Lose all cytoplasmic organelles
- Develop a thick cornified envelope

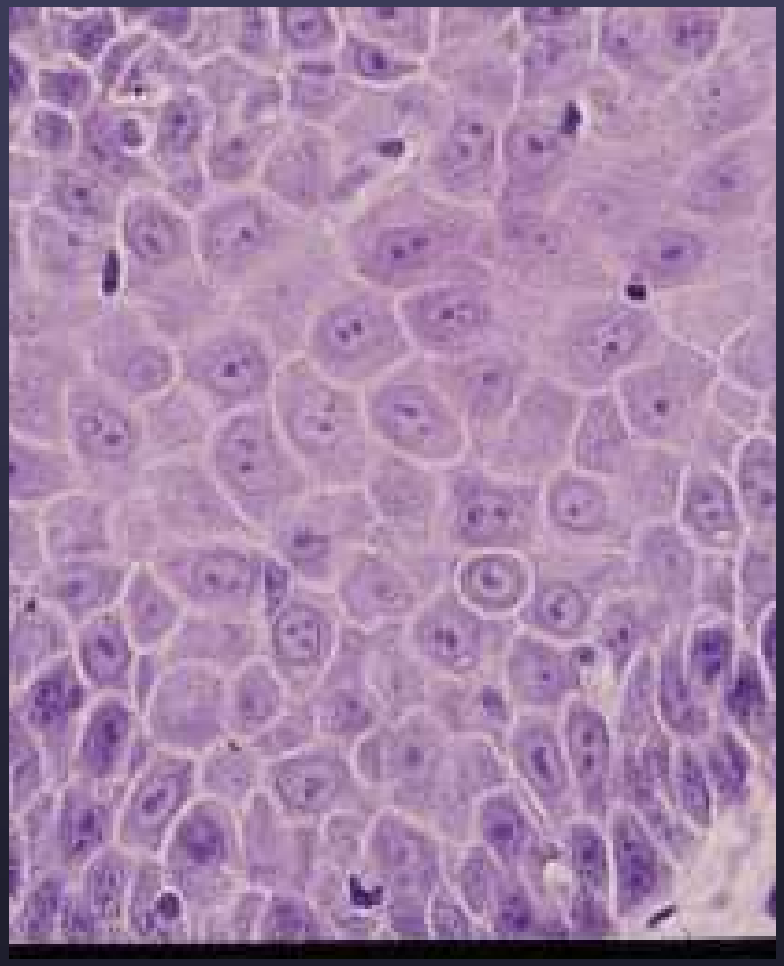


Stratum Basale

- Progenitor layer
  - Slow-cycling stem cells
  - Transiently amplifying cells
  - Terminally differentiated cells
- Rests on BMZ
  - Hemidesmosomes
- Melanocytes

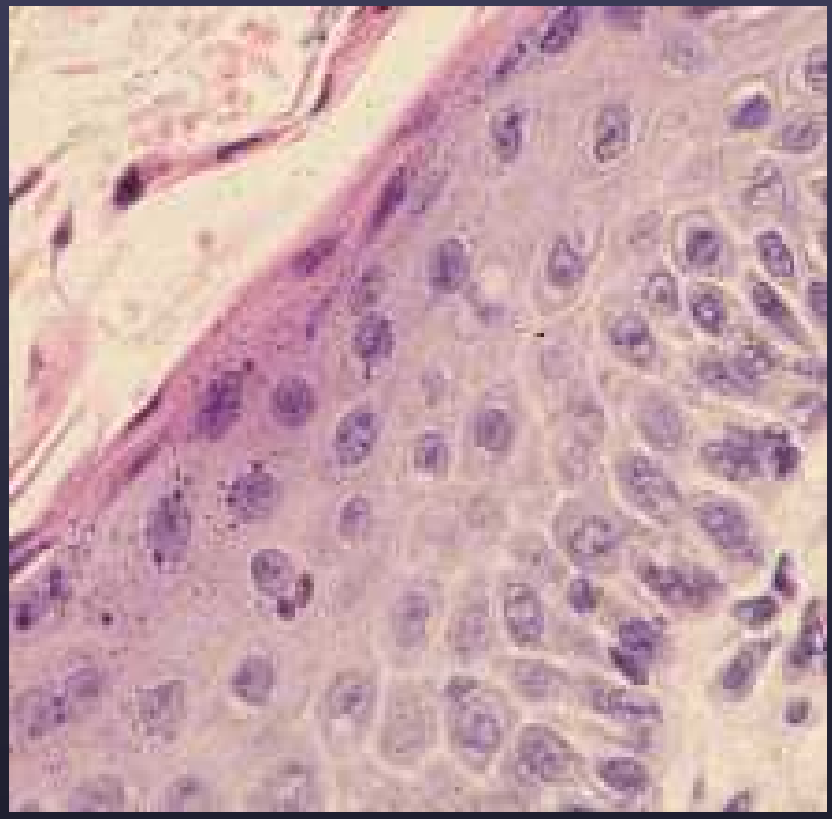
Stratum Spinosum

- Prominent intercellular attachments (desmosomes)
- Cells become larger, flatten out
- May contain Langerhans cells



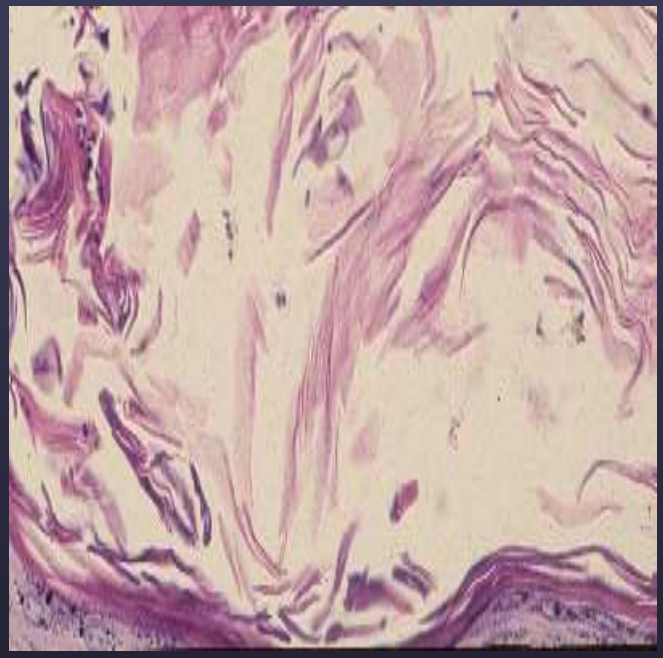
Stratum Granulosum

- Layer of flattened keratinocytes
- Basophilic (keratohyalin) granules
- Profilaggrin- a precursor of filaggrin
  - Aggregates keratin filaments.
- Variably present in domestic animals



Stratum Corneum

- Fully keratinized, anucleate, dead cells
- > 20 layers
- Continuously shed
- Keratin and intercellular lipids
  - "mortar and bricks"
- Major structural barrier



Langerhans Cells

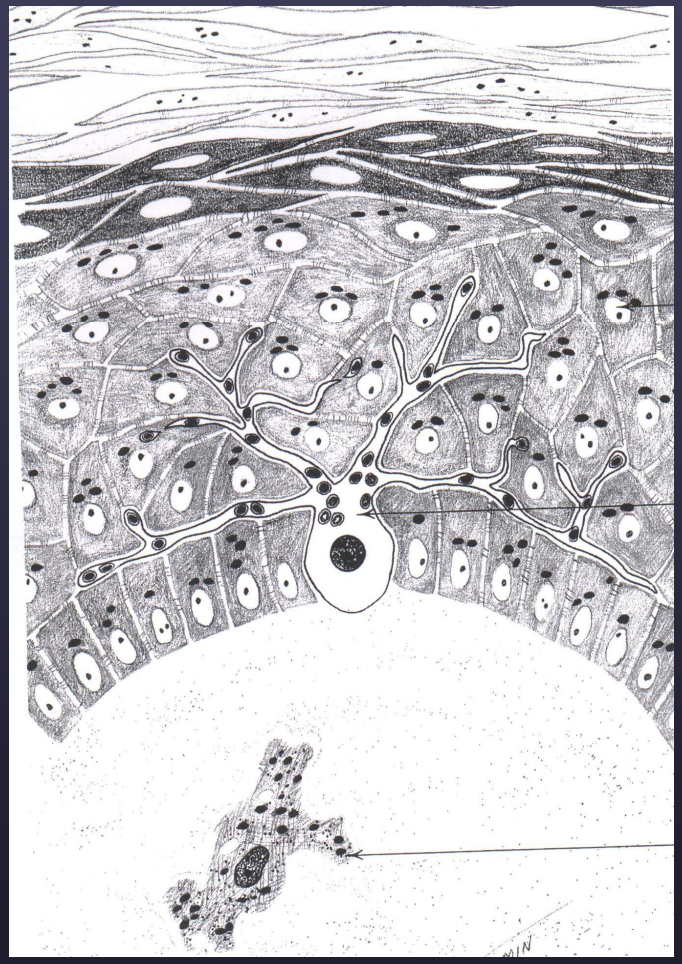
- *Very Important*
  skin immune system
- Dendritic cells
- Bone marrow derived
- Antigen processing
- Emigrate from epidermis, migrate to LN, present Ag to T cells

Contact Hypersensitivity

Darwin Award

Melanocytes

- Basal cell layer of epidermis, anagen hair follicles
- Transfer melanin to keratinocytes
- Epidermal melanin unit
  - One melanocyte per 10-20 keratinocytes



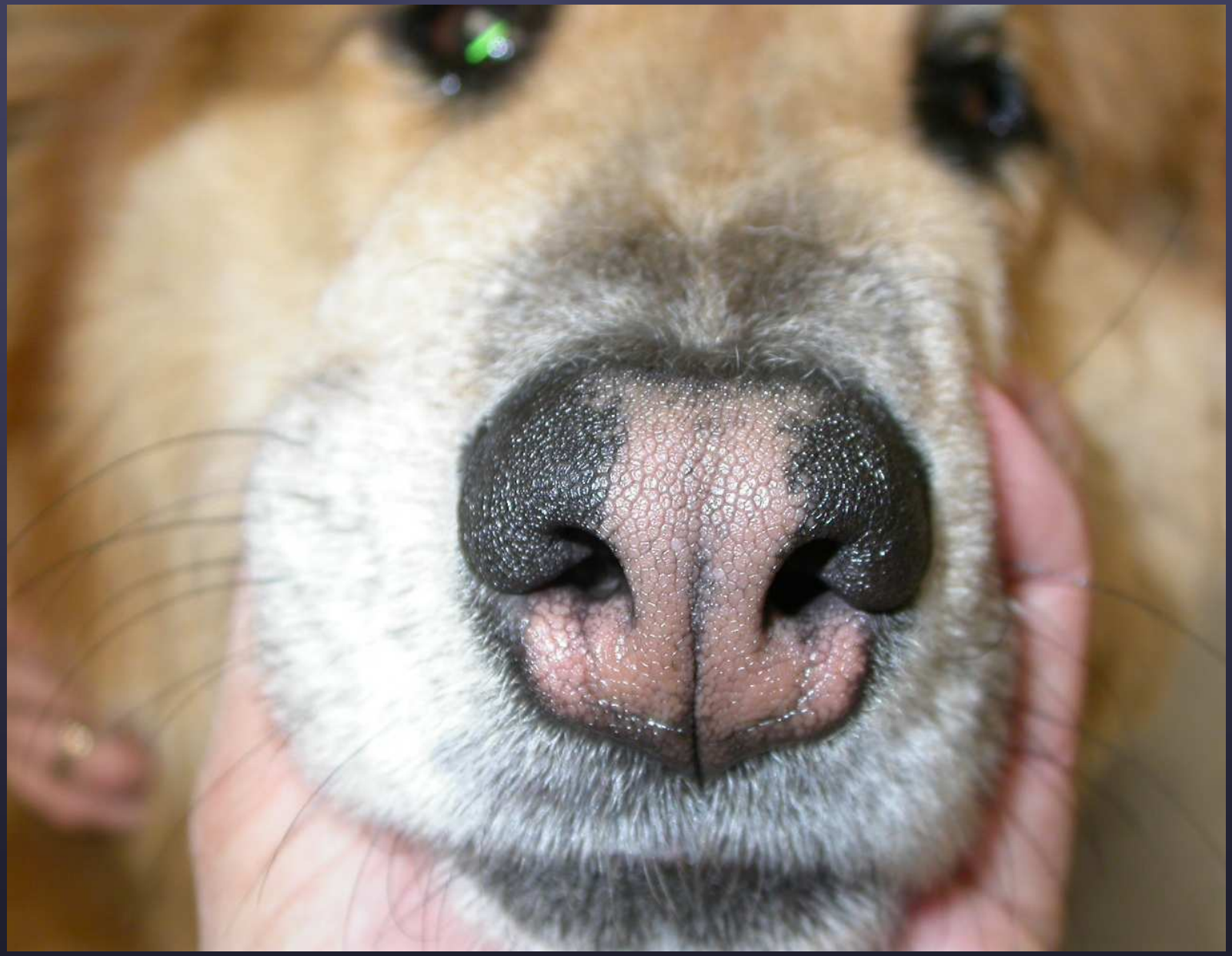
► Ackerman's Histologic Diagnosis of Inflammatory skin diseases, 1978

Melanocyte Function

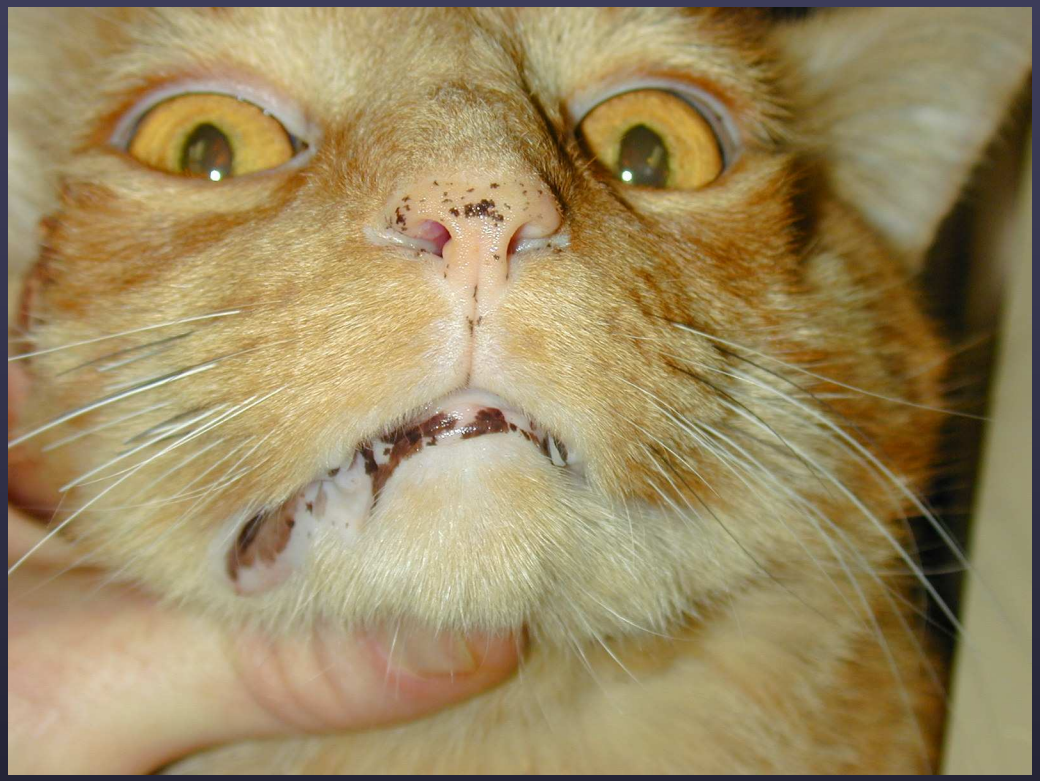
- Solar protection
- "Tanning"
- Absorb UVR and scavenge free radicals
- Hyperpigmentation following injury
- Escape predators

Skin disorders due to abnormal melanization

- Post-inflammatory hyperpigmentation
- Color dilution alopecia/Black hair follicular dysplasia
- Vitiligo
- Melanoma



- "Snow nose or Dudley nose"



- Lentigo simplex in orange cats

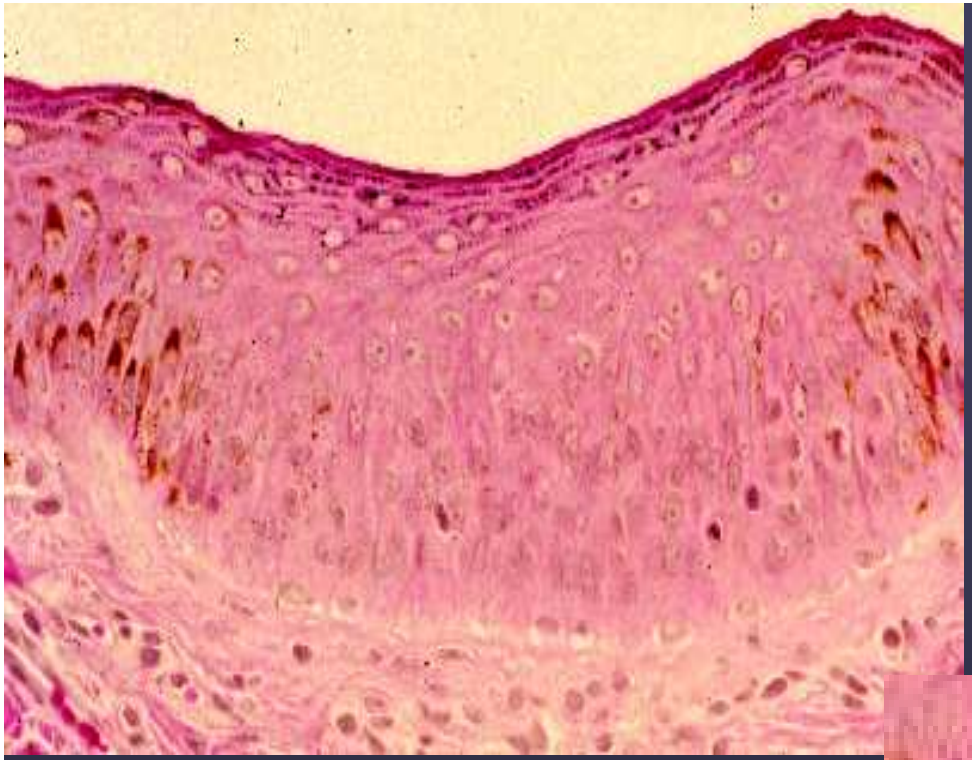
- vitiligo

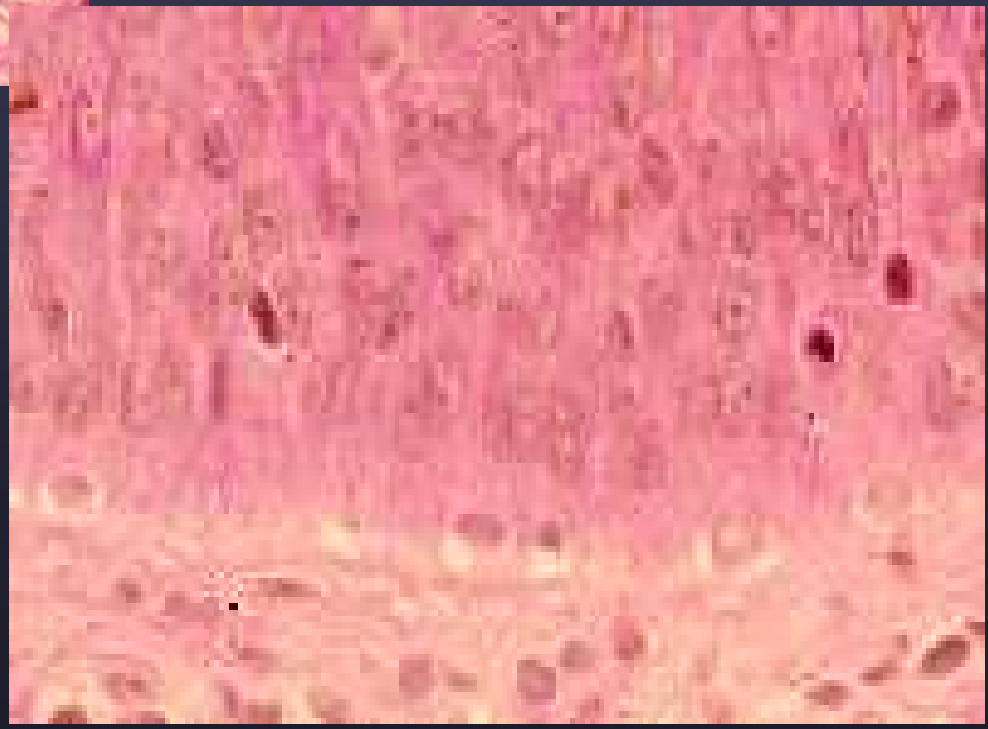
- Black hair follicular dysplasia

- Melanocytoma

Merkel Cells

- Features of epithelial and neuroendocrine cells
- Mechanoreceptors in tylotrich pads and hair follicles

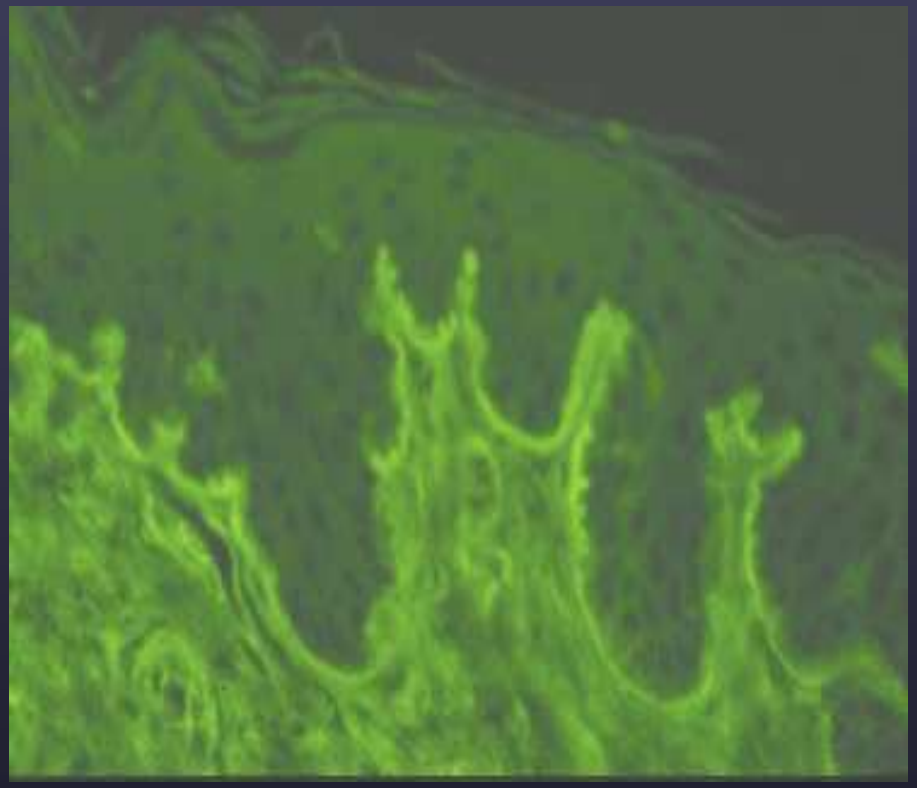




Merkel cells in tyotrich pad

Basement Membrane Zone

- anchors epidermis to dermis
- protective barrier
- wound healing
- site of many pathologic processes
- Example: Epidermolysis bullosa

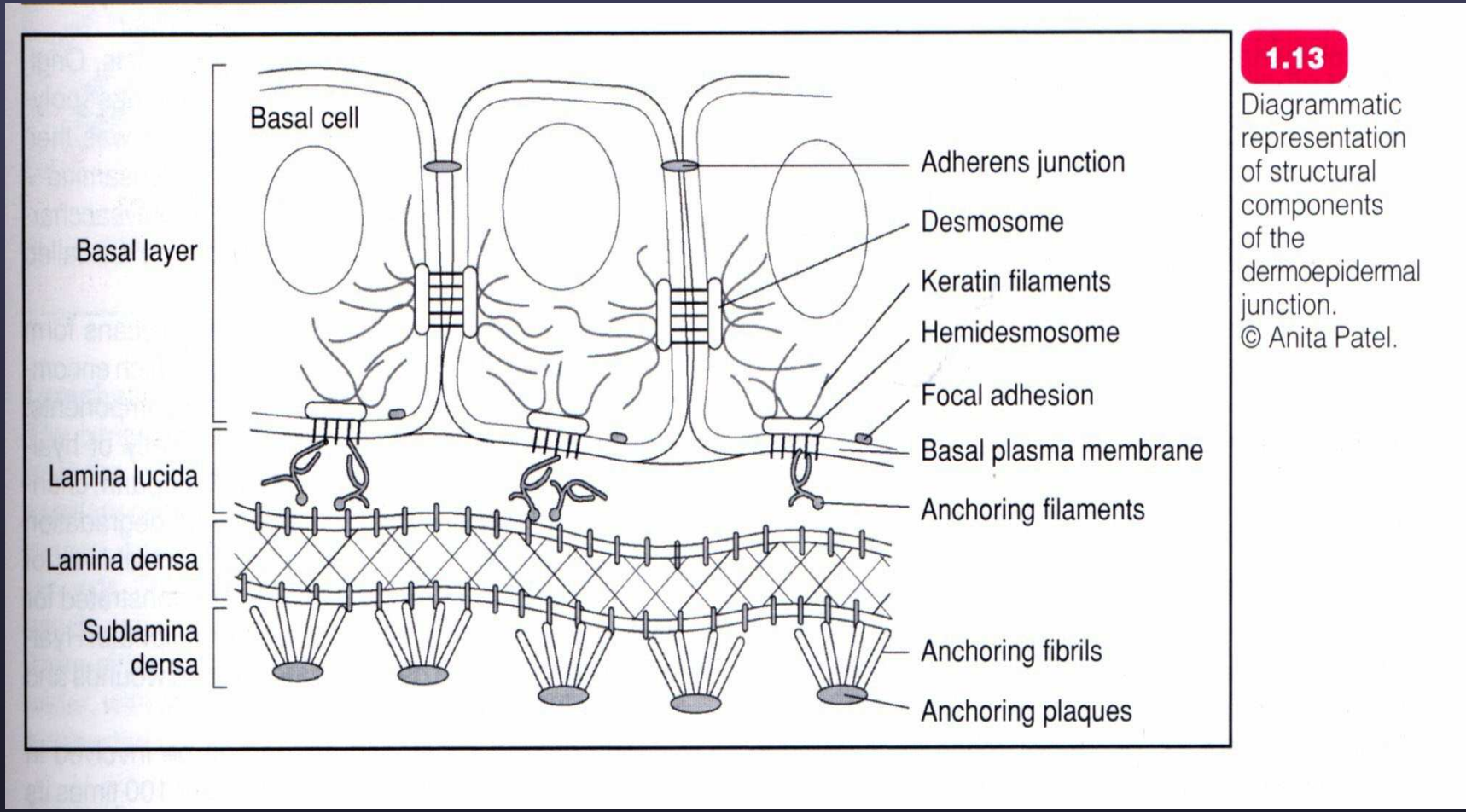


Nonspecific Ig staining of BMZ

Basement Membrane

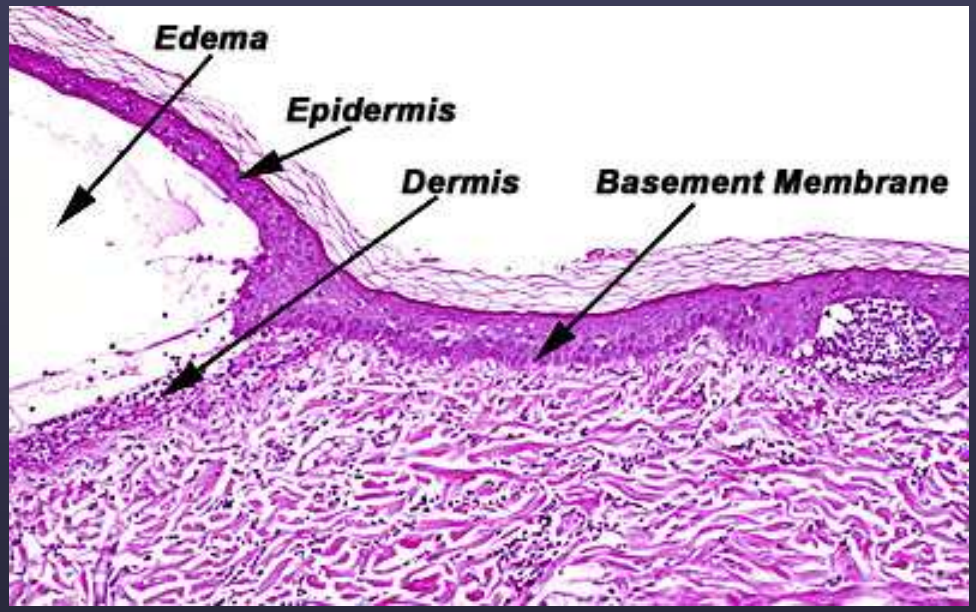
- **Hemidesmosomes** of basal cells
  - **Inner and outer plaques**
- **Lamina lucida**- clear zone seen on electron microscopy
- **Lamina densa**- contains primarily Type IV collagen
- **Sublamina densa**- anchoring fibrils- Type VII collagen

Basement Membrane Zone



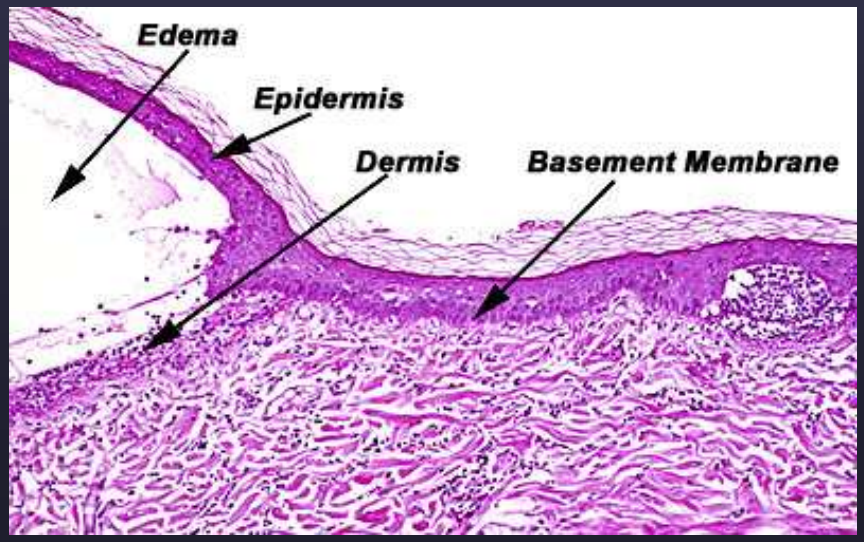
1.13 Diagrammatic representation of structural components of the dermoepidermal junction. © Anita Patel.

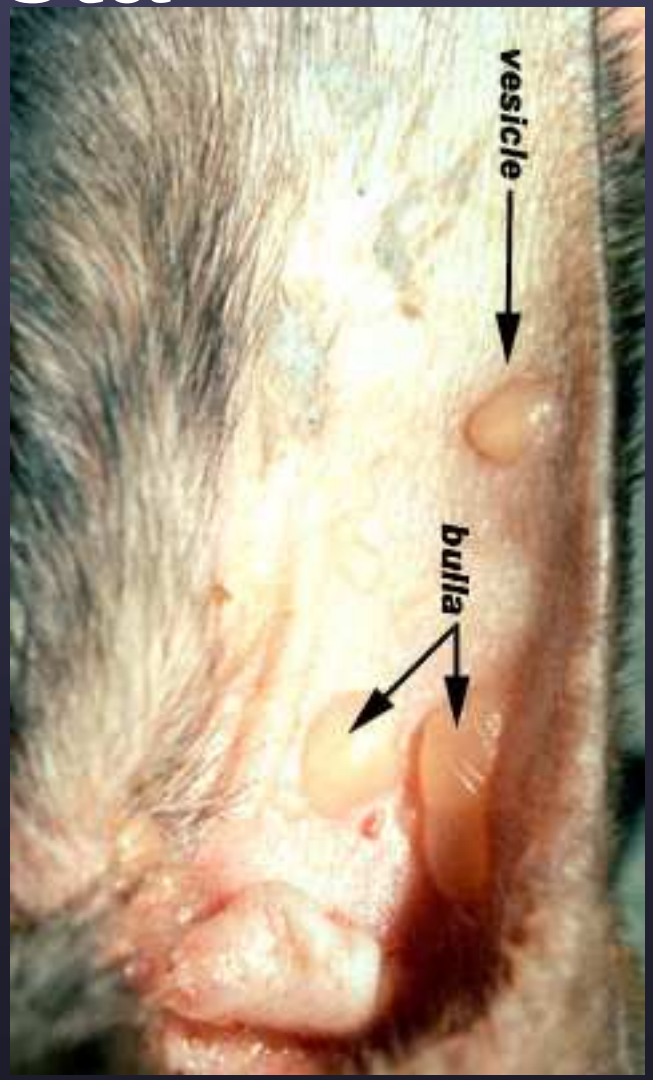
- BSAVA Manual of Small Animal Derm, 2003



Ab to Collagen VII

Epidermolysis Bullosa Acquista





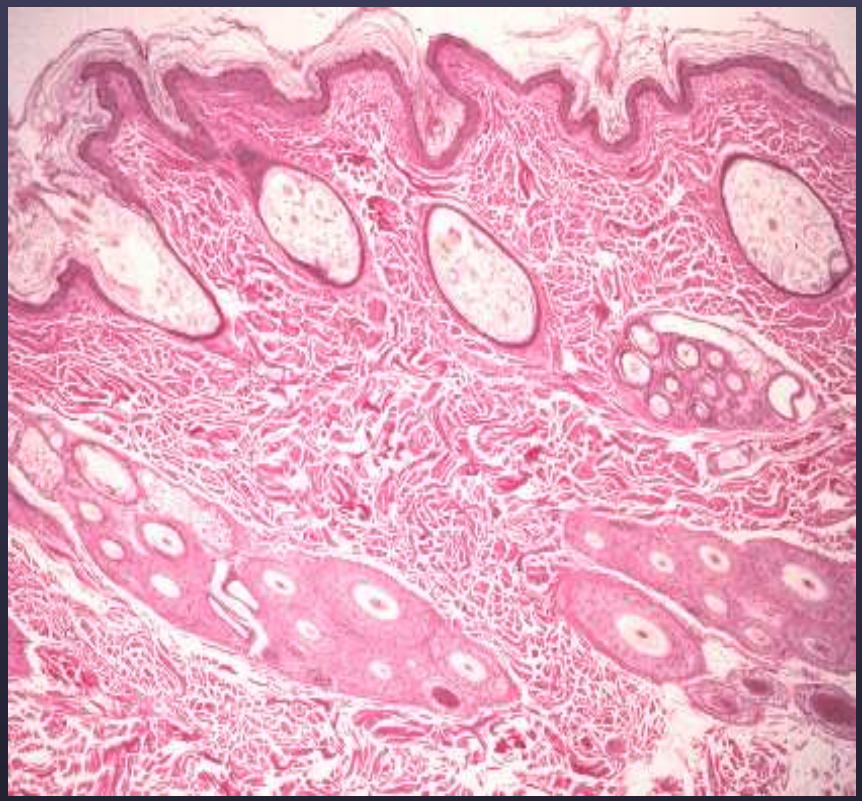
6 mo. old Great Dane

- Thermal burn

- Scarring alopecia

Dermis: Superficial and Deep

- Collagen, elastin, proteoglycans.
- perivascular dendritic cells, lymphocytes, mast cells
- Tensile strength
- Supports blood vessels, lymphatics, nerves



Dermis of a Shar Pei Dog

- Dermal mucin- Alcian blue stain

- Cutaneous mucinosis

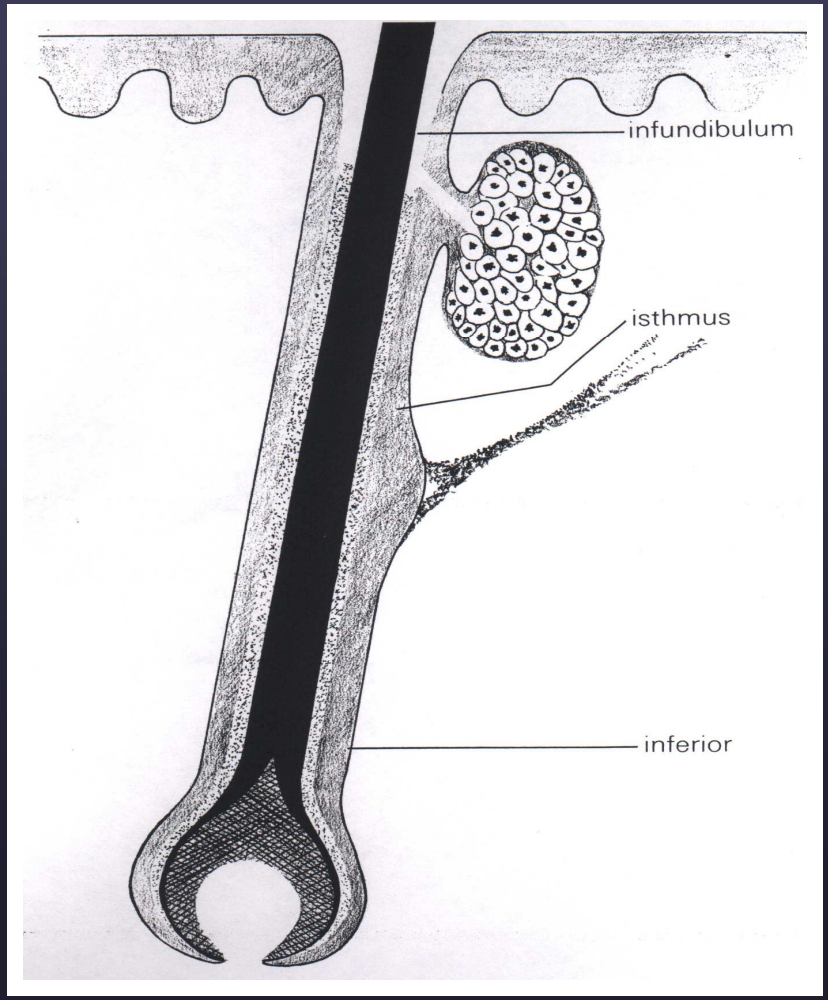
- Cutaneous asthenia

Hypovitaminosis C (Scurvy)

Hair Follicles

- Physical and photoprotective barrier
- Visual stimulus for sexual attraction
- Thermoregulation
- Sensory perception
- Wound healing

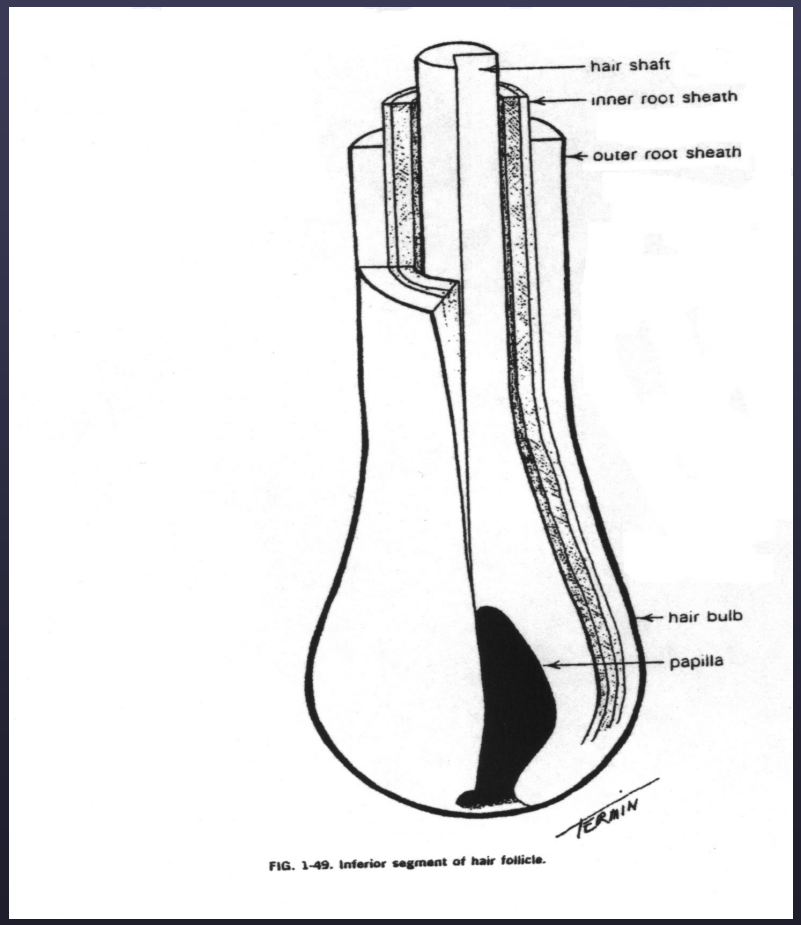
Hair Follicle Structure



- Ackerman's Histologic Diagnosis of Inflammatory skin diseases, 1978

Structure of Hair

- Outer root sheath continuous with epidermis.
- Outer root sheath surrounds an inner tube (inner root sheath).
- These two tubes surround the hair shaft.
- Hair bulb: base of follicle



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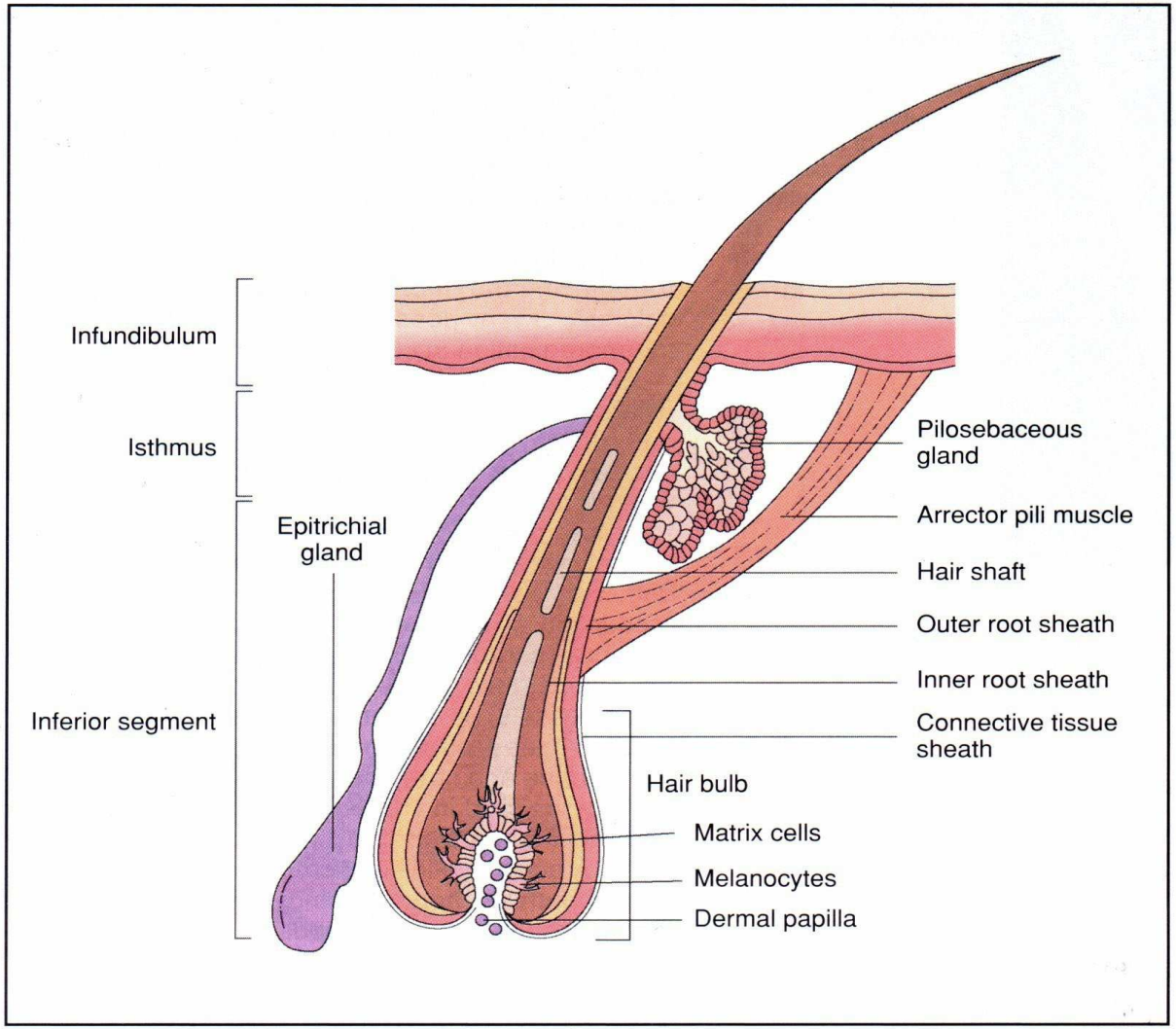
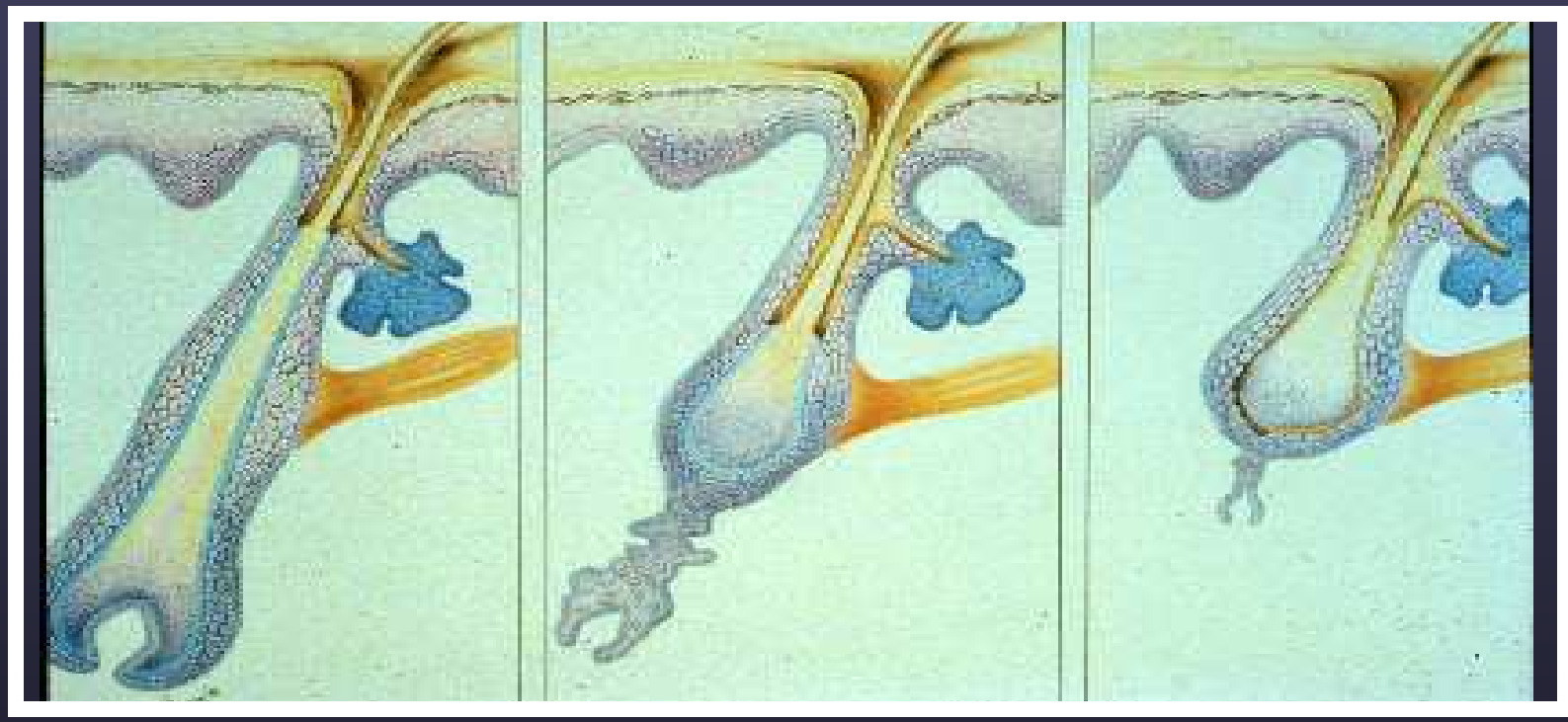


1.8 The hair follicle and its associated structures. © Anita Patel.

- BSAVA Manual of Small Animal Derm, 2003

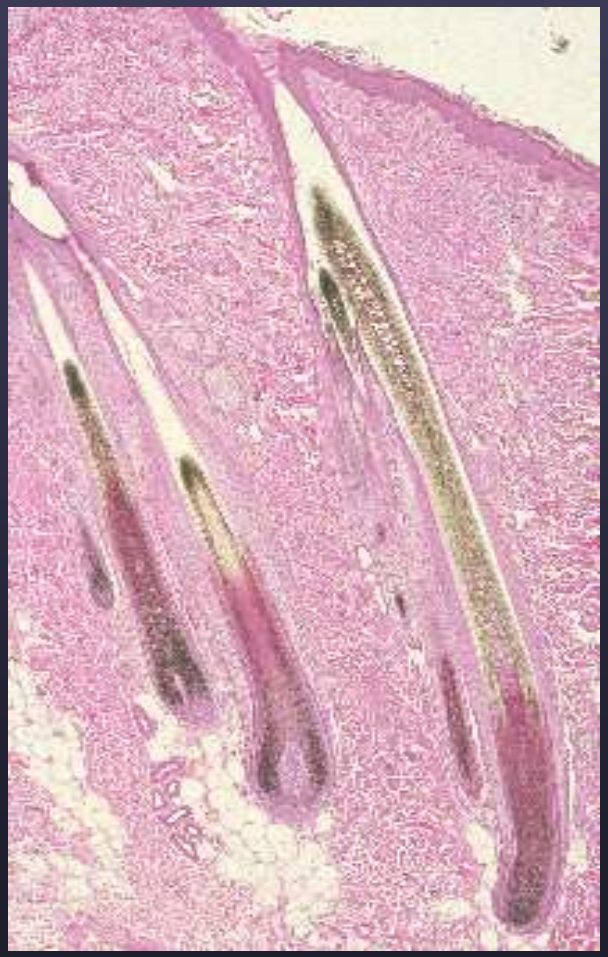
Hair Cycle



Anagen Catagen Telogen

- Fitzpatrick's Dermatology in General Medicine, 1999.

Anagen Follicle



Telogen follicle

Stages of Hair Cycle

- Equine

Species differences

- Simple follicles
  - Humans, cattle, horses, rats and mice
- Compound follicles
  - Dogs, cats, sheep, goats
  - Sheep- secondary follicles have secondary follicles
- Hair cycle duration

Disorders affecting hair follicles

- Inflammation→ **Folliculitis→ Furunculosis**
- Hair follicle dysplasia
- Hair cycling Disorders
- Atrophy/Miniaturization

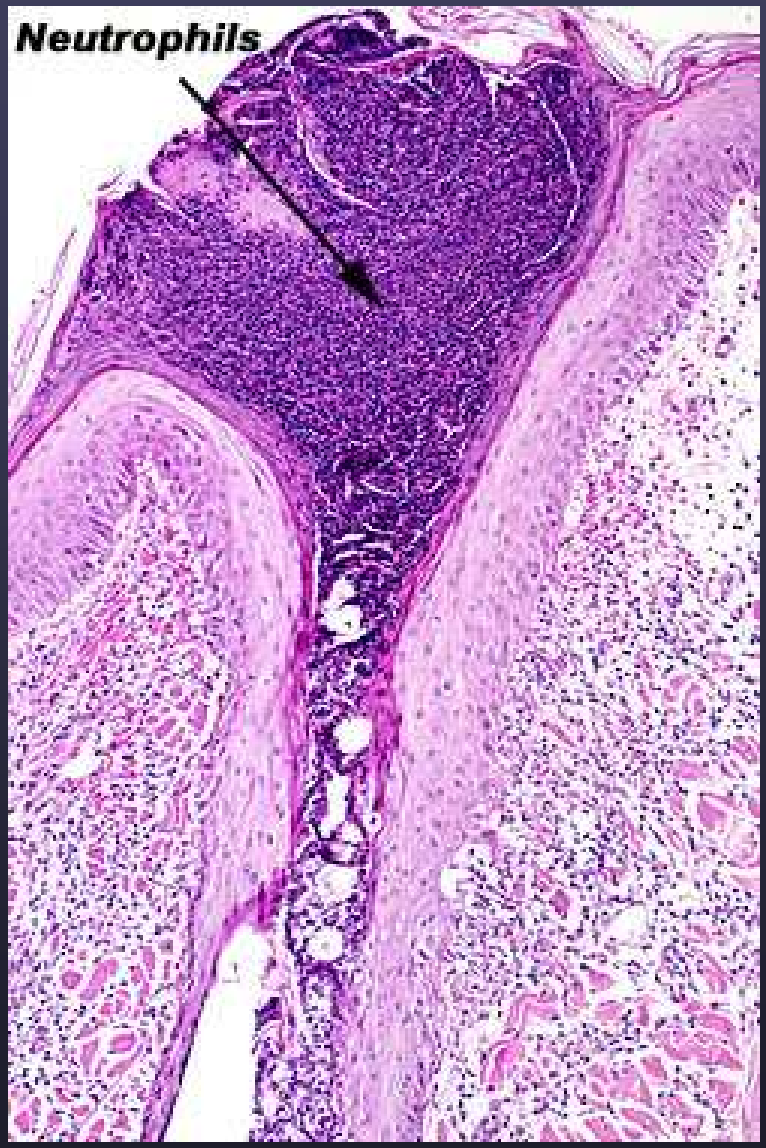
Hormonal Influence on Hair cycle

- Hormones which stimulate anagen
  - Thyroid hormone
  - Androgens
- Hormones which inhibit anagen
  - Glucocorticoids
  - Estrogen

Specialized Hair

- **Sinus hairs (whiskers and vibrissae)**
  - **slow-adapting mechanoreceptors**
- **Tylotrich hairs**
  - **rapid adapting mechanoreceptors**
  - **scattered among normal hair**
  - **Merkel cells in tylotrich pads**

Tactile Hair

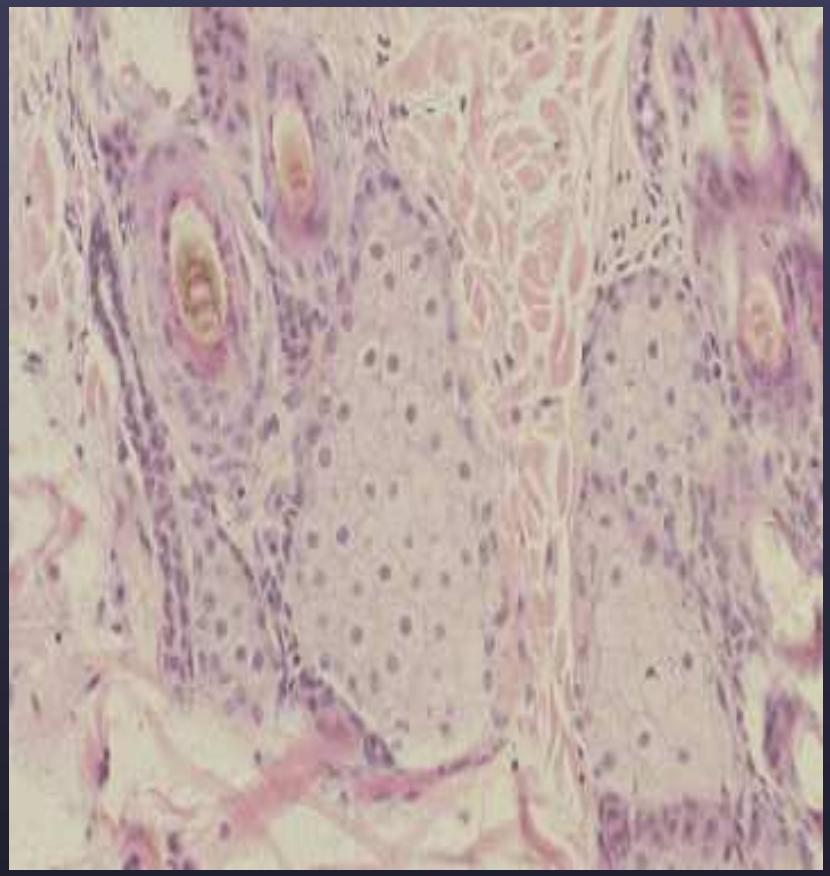

Neutrophils

- Folliculitis in short-coated breed dog

Sebaceous glands

- Holocrine glands open into the hair follicle
- Sebocytes degenerate to form sebum
- Provides moisture for stratum corneum, water repellant
- Antibacterial activity, pheromone production
- Example: Sebaceous adenitis

Sebaceous Glands

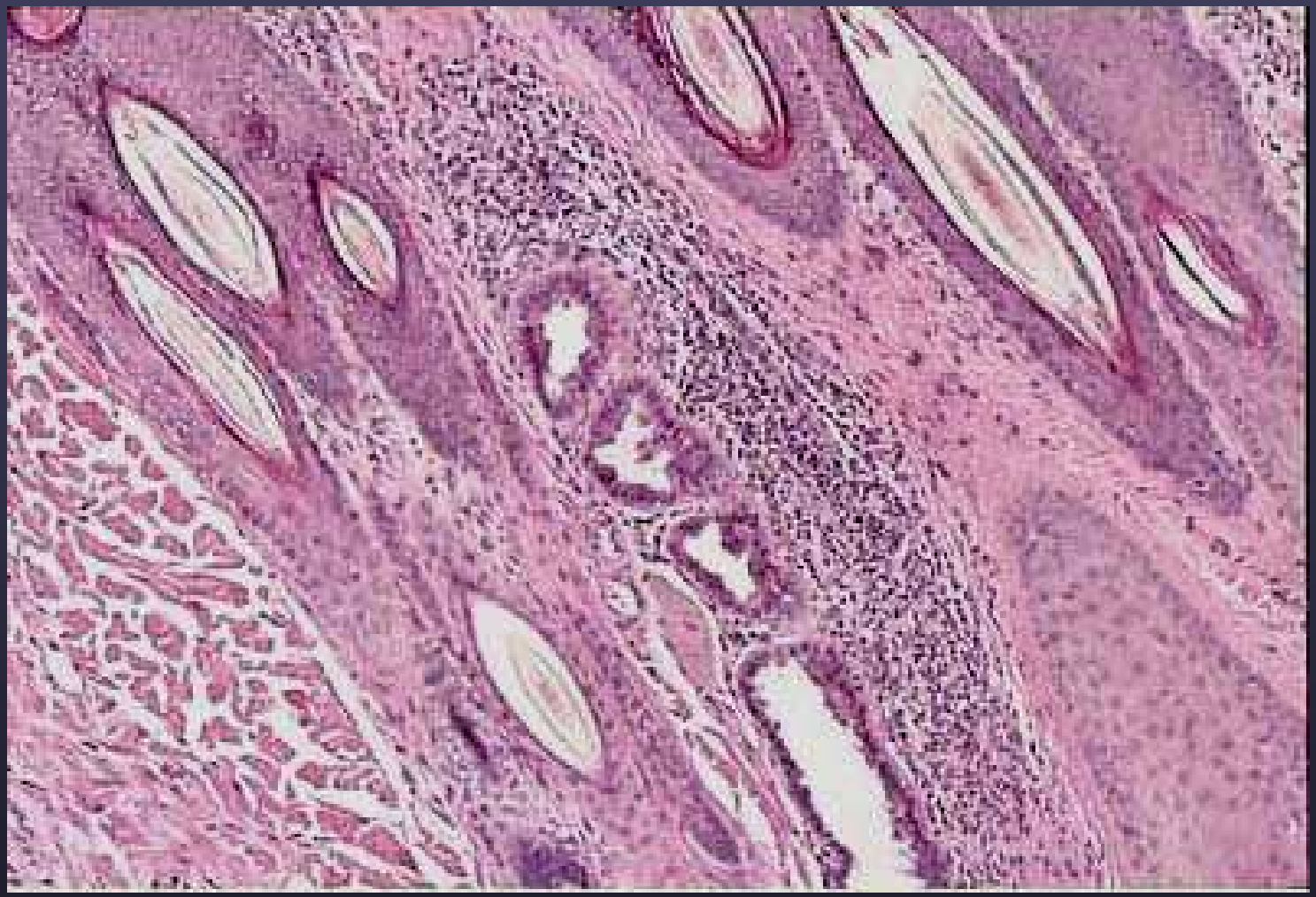


Feline

2 year old, FS, Standard Poodle

- Sebaceous adenitis

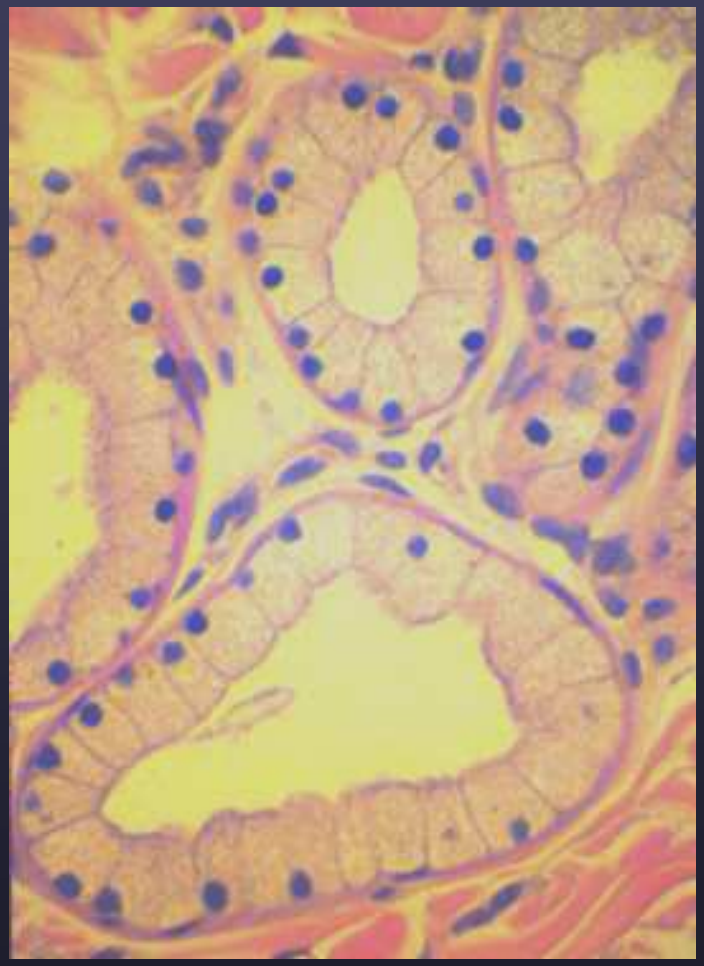
- Follicular casts



- Sebaceous adenitis

Sweat Glands

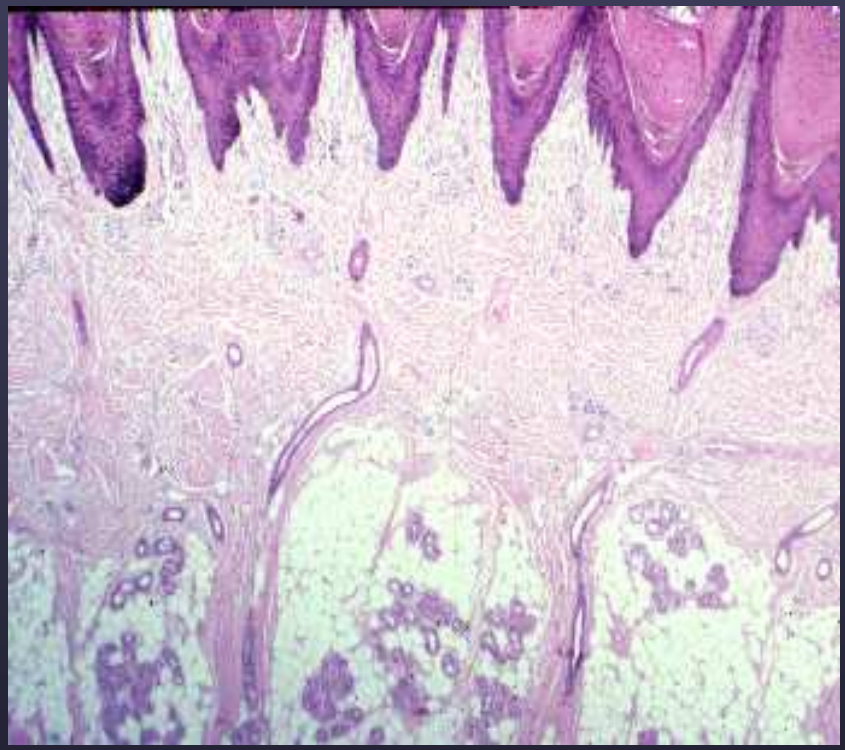
- **Apocrine glands (epitrichial)**
  - **empty into hair follicle.**



- equine

Apocrine Glands

- **Eccrine glands (atrichial)**
  - **present in foot pads**
  - **empty directly onto surface of skin.**



Subcutis

- Between the dermis and skeletal muscle
- Adipose tissue (panniculus) and loose connective tissue.
- Metabolic storage pool
- Protects deeper structure
- Inflammation of panniculus = panniculitis

Cutaneous Vasculature

- No direct blood flow
- Superficial plexus
- Middle plexus
- Deep plexus

Joshua tree at night