

Skin

The skin is the largest and most visible organ of the body and the anatomic and physiologic barrier between animal and environment. It provides protection from physical, chemical, and microbiologic injury, and its sensory components perceive heat, cold, pain, pruritus, touch, and pressure.

In addition, the skin is synergistic with internal organ systems and thus reflects pathologic processes that are either primary elsewhere or shared with other tissues.

The general functions of animal skin are as follows:

1. Enclosing barrier:

The most important function of skin is to make possible an internal environment for all other organs by maintaining an effective barrier to the loss of water, electrolytes, and macromolecules.

2. Environmental protection:

A corollary function is the exclusion of external injurious agents (chemical, physical, and microbiologic) from entrance into the internal environment.

3. Motion and shape:

The flexibility, elasticity, and toughness of the skin allow motion and provide shape and form.

4. Adnexa production:

Skin produces glands and keratinized structures such as hair, hoof, and the horny layer of the epidermis.

5. Temperature regulation:

Skin plays a role in the regulation of body temperature through its support of the hair coat, regulation of cutaneous blood supply, and sweat gland function.

6. Storage:

The skin is a reservoir of electrolytes, water, vitamins, fat, carbohydrates, proteins, and other materials.

7. Indicator:

The skin may be an important indicator of general health, internal disease, and the effects of substances applied topically or taken internally. It contributes to physical and sexual identity.

8. Immunoregulation:

Keratinocytes, Langerhans' cells, lymphocytes, and dermal dendrocytes together provide the skin with an immunosurveillance capability that effectively protects against the development of cutaneous neoplasms and persistent infections.

9. Pigmentation:

Processes in the skin (melanin formation, vascularity, and keratinization) help determine the color of the coat and skin. Pigmentation of the skin helps prevent damage from solar radiation.

10. Antimicrobial action:

The skin surface has antibacterial and antifungal properties.

11. Sensory perception:

Skin is a primary sensory organ for touch, pressure, pain, itch, heat, and cold.

12. Secretion:

Skin is a secretory organ by virtue of its epitrichial sweat glands, and sebaceous glands.

13. Excretion:

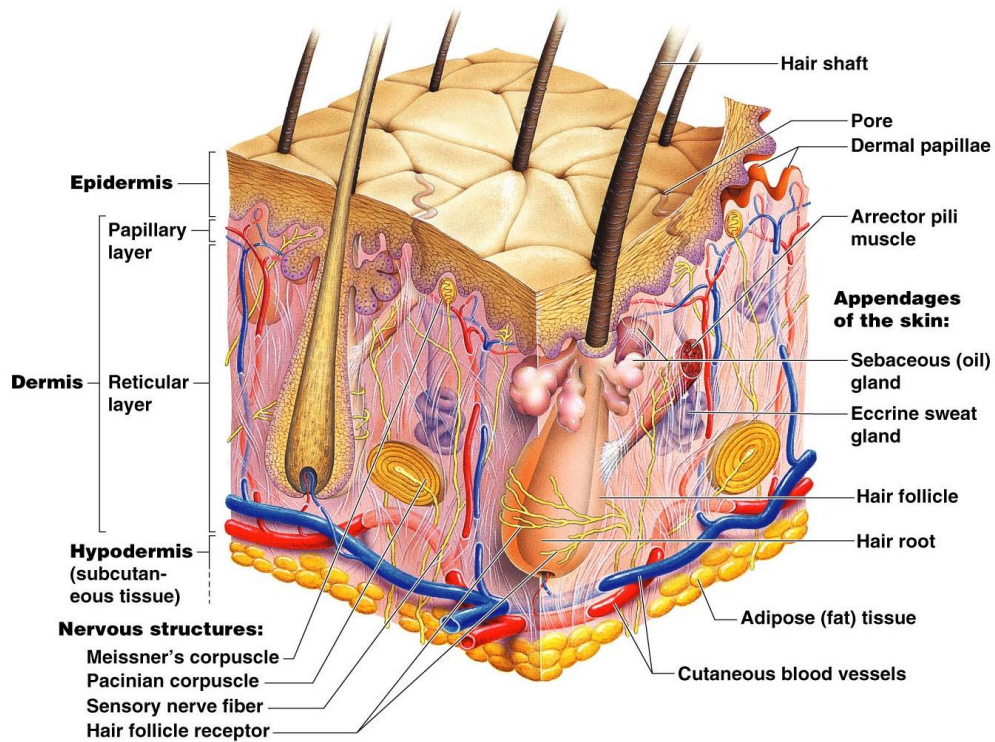
The skin functions in a limited way as an excretory organ.

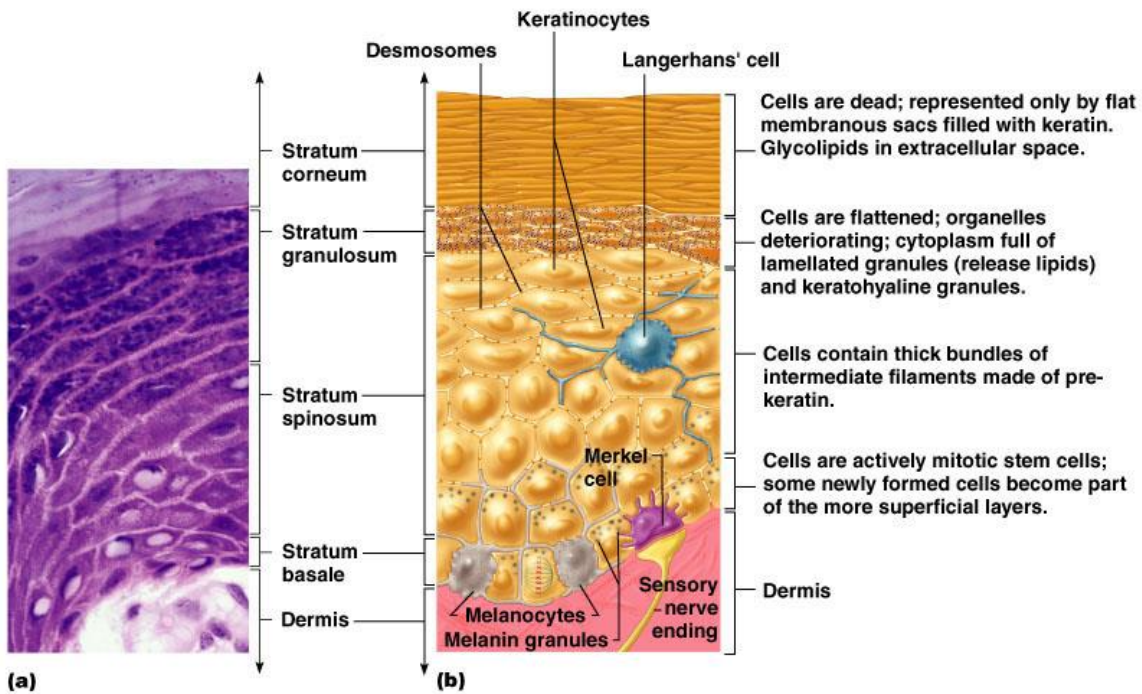
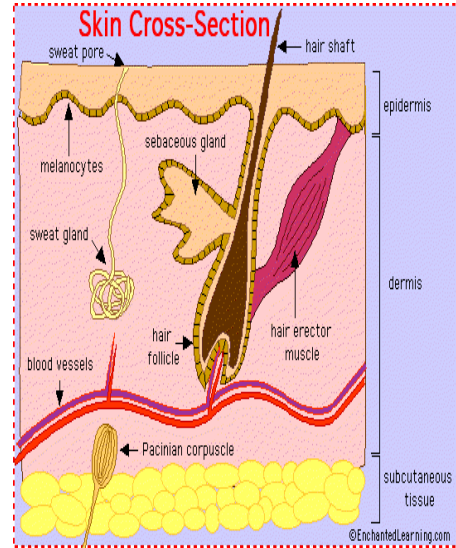
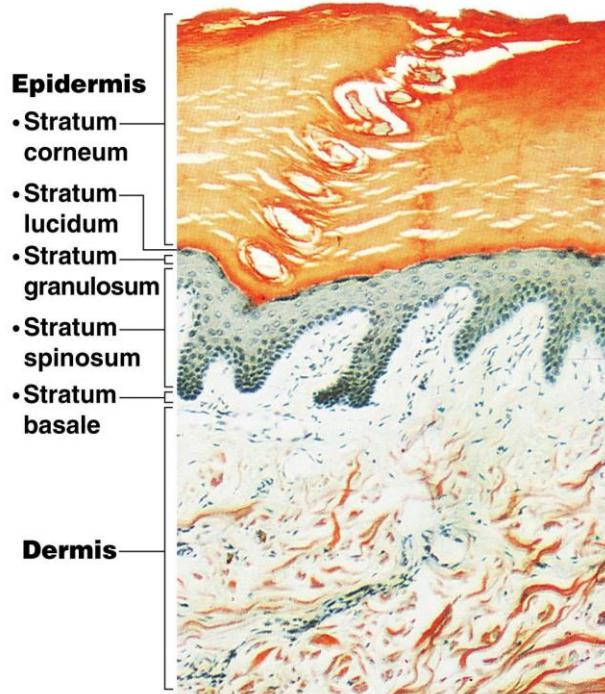
14. Vitamin D production:

Vitamin D is produced in the skin through stimulation by solar Radiation In the epidermis, vitamin D₃ (cholecalciferol) is formed from provitamin D₃ (7-dehydrocholesterol), via previtamin D₃ on exposure to sunlight. The vitamin D-binding protein in plasma translocates vitamin D₃ from the skin to the circulation. Vitamin D₃ is then hydroxylated in the liver to 25-hydroxyvitamin D₃ and again hydroxylated in the kidney to form 1,25-dihydroxyvitamin D₃, which is important in the regulation of epidermal proliferation and differentiation.

Basic structure of the skin:

- ▶ **Epidermis:** outer layer
- ▶ **Dermis:** Dense connective tissue
- ▶ **Hypodermis:** Subcutaneous tissue - Not part of the skin - Anchors skin to underlying organs, bones and muscles





Normal skin structure:

The skin is the largest organ of the body and consists of the following components:

1- Epidermis

- is composed of several cell types, ie keratinocytes, melanocytes, Langerhans cells, Merkel cells.

2- Dermis

- consists of **fibers** (collagen, reticulin, elastin), **ground substance** (glycosaminoglycans, proteoglycans), **cells** (fibroblasts, mast cells, histiocytes, smooth muscle), **vessels** (blood, lymph), **nerves**.

- **Hypodermis** (subcutis): Not part of skin and consists of **lipocytes**, **fibers** (collagen, elastin), **vessels**, **nerves**.

Adnexa (appendages of the skin):

Hair, glands (sebaceous, apocrine, eccrine; also circumanal, tail, anal), claws / nails and hooves.

Epidermis is continuously renewed; keratinocytes arising from stem cells in the basal layer differentiate as they move through the spinous, granular & corneum layers and are then shed from the surface.

keratinocytes are tightly bonded to each another by spot-like adhesion structures called desmosomes.

- the thickness of the stratum spinosum is inversely proportional to the thickness of the hair coat; ie very thin epidermis in dogs and cats, thicker in horses and cattle and thickest in pigs and humans.

- **melanocytes** are typically scattered throughout the basal layer of the epidermis (& hair bulbs) where they inject melanin pigment granules into keratinocytes (& hair) to provide coloration and protection against UV-light.

- **Langerhans (dendritic) cells** are antigen processing & presenting cells scattered throughout the epidermis.

- **Merkel (tactile) cells** have both mechanoreceptor and neuroendocrine functions.

Skin diseases

Principal manifestations of skin diseases:

1. Dermatological lesions
2. Abnormal coloration of skin
3. Pruritus
4. Abnormalities of sweat gland secretion
5. Abnormalities of sebaceous gland secretion
6. Abnormalities of sebaceous gland secretion

Dermatological lesions: Skin lesions may be primary or secondary.

Primary Lesions - are the direct result of the underlying disease process; most important diagnostically

- a) **Macule** - a circumscribed, area of discoloration (eg pigmentation, hemorrhage) up to 1 cm in diameter.
- b) **Patch** - a macule over 1 cm in size.
- c) **Papule** - a small (< 1 cm diameter) solid elevation of the skin.
- d) **Plaque** - a larger, flat-topped elevation formed by the extension or coalescing of papules.
- e) **Nodule** - a circumscribed, solid elevation >1 cm in diameter that usually extends into the deeper layers.
- f) **Tumor** - a large mass (neoplasia implied) that may involve any structure of the skin or subcutis.
- g) **Cyst** - an epithelial lined cavity in the dermis or subcutis containing fluid or semisolid material.
- h) **Vesicle** - a well circumscribed, < 1 cm diameter, elevation of the epidermis, filled with clear fluid.
- i) **Bulla** - a vesicle (blister) > 1 cm diameter.
- j) **Pustule** - a small, circumscribed, pus filled elevation of the epidermis.
- k) **Abscess** - a well demarcated fluctuant lesion resulting from dermal or subcutaneous accumulation of pus.
- l) **Wheal** - a sharply circumscribed, raised lesion due to dermal edema; will blanch with pressure.

Skin Lesions That May Be Primary or Secondary

- a) **Scale** - an accumulation of loose fragments (flakes / dandruff) of cornified skin; can be primary (eg primary seborrhea) or secondary (eg chronic inflammation).

b) **Crust** - accumulation of dried material (eg exudate, blood /serum, scale, medication) on skin surface;

can be primary (eg zinc-responsive dermatosis) or secondary (eg self-trauma, pyoderma, etc).

c) **Comedo** - a hair follicle lumen plugged with cornified cells and sebaceous material;

can be primary (eg Cushing's disease) or secondary (eg demodecosis).

Secondary Lesions - evolve from primary lesions, via self-trauma, altered keratinization, etc.

a) **Epidermal collarette** - a circular rim of keratin flakes following loss of the "roof" of a vesicle or pustule.

b) **Erosion** - a shallow epidermal defect that doesn't penetrate the basal laminar zone; heals without scarring.

c) **Ulcer** - a break in the epidermis with exposure of the underlying dermis; usually heals with a scar.

d) **Excoriation** - erosions or ulcers caused by scratching, biting or rubbing, usually due to pruritus.

e) **Scar** - an area of fibrous tissue that has replaced the damaged dermis and/or subcutis.

f) **Fissure** - a linear cleavage of usually thickened, inelastic skin.

g) **Lichenification** - a thickening and hardening of the skin with exaggeration of the superficial markings.

h) **Callus** - a thickened, rough, alopecic, lichenified plaque that develops on the skin.

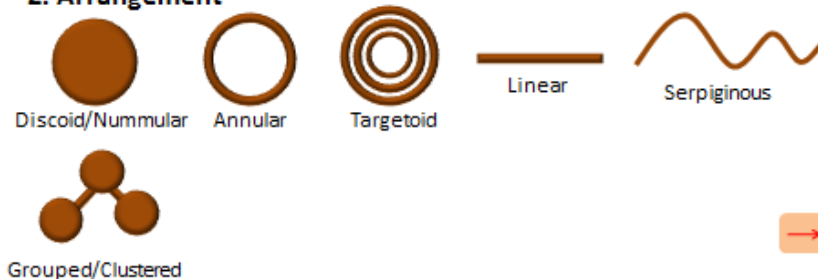
Skin lesions are described based on:

- **Shape**
- **Arrangement (configuration)**
- **Distribution**

1. Shape



2. Arrangement



3. Distribution of skin lesions:

Regional location and symmetry or asymmetry of skin lesions are important diagnostic aids.

Abnormal Pigmentation or Coloration:

Red (erythema) - inflammation / vasodilation

Black - melanoderma (hypermelanosis) / melanotrichia

White - leukoderma / leukotrichia / hereditary hypopigmentation (eg albinism)

Red-purple-brown-black - macular hemorrhage < 1 cm (petechiae /purpura); > 1cm = ecchymoses

Yellow - icterus

Blue – cyanosis

Abnormalities of hair and wool fibers:

Hair is produced in hair follicles by matrix cells overlying the dermal papillae in the bulb region of the follicle. each hair shaft has an inner (medulla), middle (cortex), and outer (cuticle) layer.

- Two main types of hair; ie long, coarse primary (guard) hairs of the outercoat and shorter, finer secondary hairs that form an undercoat.

- Each primary follicle has an attached arrector pili muscle, sebaceous and apocrine gland, while secondary follicles may have only sebaceous glands.

- Dogs & cats have compound follicles; varying numbers (ie 5-20 secondary to 1 primary follicle) and length of secondary follicles accounts for the breed variation of coats

- Horses & cattle have evenly distributed simple primary follicles; pigs have simple follicles grouped in clusters.

- sheep have simple follicles in hair-growing areas and compound follicles in wool-growing areas.

The Hair Cycle

- hair growth is not continuous; it occurs in phases, ie anagen (growth), catagen (transition) & telogen (resting)
- In anagen, hair is produced by mitosis of the hair matrix cells which surround the dermal papilla in the bulb.
- catagen is a short regressing stage, which indicates the end of active growth and the formation of a “club” hair.

- telogen is the resting stage, during which the non-growing club hair remains attached for a variable period of time before it falls out and is replaced by an underlying new anagen follicle.
- average human head has 100,000 hairs with 90% of head hair in anagen which can last for 2-6 yrs (genetically determined) and 10% in catagen / telogen for 2-6 months (randomly distributed so you don't notice loss of fifty to 100 club hairs per day).
- in dogs, anagen can be 3-4 months in short-coated & 18 months in long-coated breeds; telogen phase can range in various breeds from months to years. in dogs, and many other mammals, the hair cycle can be somewhat synchronized (ie shedding) which is influenced by genetics, photoperiod, temperature, nutrition, health status & hormones.
- In severe illness many hairs can synchronously be "pushed" into telogen and then can be shed together; called telogen defluxion or telogen effluvium.
- since hair is predominantly protein, malnutrition can cause a poor quality haircoat, ie dull, dry, brittle &/or thin.

Abnormalities of hair:

Alopecia:

partial to complete loss of hair (baldness); can be primary (eg endocrine disease, follicular dysplasia) or secondary (eg with self-trauma or inflammation).

Hypotrichosis / atrichia :

Less hair than normal or absence of hair (ie failure to develop).

Effluvium / defluxion :

excessive shedding or falling out of the hair.

Hypertrichosis (hirsutism):

excessive growth of hair.

Pruritus (Itching):

It is the sensation that gives rise to desire to scratch, biting or rubbing against any convenient agent. Pruritus may be generalized as pseudorabies or localized as mange.

Types of pruritus:

1. Peripheral origin: it is a primary cutaneous sensation with heat, cold, pain and touch due to secretion of histamine. E.g mange, lice

2. Central origin: due to stimulation of scratching center in medulla oblongata. It may be
 - A. Structural: e.g Scrapie , pseudorabies
 - B. Functional: e.g nervous ketosis, obstructive jaundice

Abnormalities of sweat gland secretion:

1. Hyperhidrosis: increased secretion.
2. Anhidrosis: decreased sweat gland secretion.

Abnormalities of sebaceous gland secretion:

Excess sebum secretion (seborrhea) causes oiliness of the skin. It occurs in several diseases of animals including greasy heel of horses and flexural seborrhea of cattle.