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# **Integumentary System**

- The skin is the largest organ in the body: <u>12-15% of body weight, with a surface area</u> <u>of 1-2 meters.</u>
- <u>Skin is continuous with, but structurally</u> <u>distinct from mucous membranes that line</u> <u>the mouth, anus, urethra, and vagina.</u>

# DIFFERENTS PARTS

- Integumentary System
- Follicles and Glands
- Hair and Nails
- Skin and Homeostasis
- Skin and Sensory Reception
- Skin and Synthesis
- Skin Is Selectively Permeable



Two distinct layers occur in the skin: the dermis and epidermis.

The basic cell type of the epidermis is the *keratinocyte*, which contain keratin, a fibrous protein.

Basal cells are the innermost layer of the epidermis.

*Melanocytes* produce the pigment melanin, and are also in the inner layer of the epidermis.

The dermis is a connective tissue layer under the epidermis, and contains nerve endings, sensory receptors, capillaries, and elastic fibers.



### Skin, thick trichrome

#### stratum corneum

#### stratum granulosum

#### stratum lucidum

stratum spinosum

stratum basale

dermis

### Skin, thin H&E

#### stratum corneum

stratum granulosum

stratum spinosum

stratum basale

dermis

# The stratum lucidum is found only in thick skin.



1/Stratum Germinativum (Basal Layer) Innermost layer to the Dermis Separated from the underlying Dermis by a basement membrane Cuboidal shaped cells, with large nuclei & distinct cell content, particularly **Ribosome's for Keratin production** Mitotic activity most evident in this layer, replacing cells in upper layers Approx 14 days for cells to move through this layer As the cells hit the upper part of this layer, they increase the amount of Keratin in them as Keratin granules Melanocytes are scattered throughout this layer which synthesize the black

### 3/Stratum Granulosum (Granular Layer)

Third layer

pigment Melanin

- Contains melanocytes and basophilic granules which are thought to be the precursor to Keratin
- Flattened and diamond shaped cells which are characterized by numerous, dense basophilic granules which crowd the cytoplasm and tend to obscure the tonofibrils

2/Stratum Spinosum (Prickly Layer) This second layer is sometimes considered to be part of the st. germinativum.

Polyhedral shaped cells held together by intercellular bridges (or prickles) but become flattened towards the top Prominent nuclei and cytoplasmic basophilia indicate active protein synthesis

A fibrillar protein aggregates in these cells to form intracellular fibrils known as tonofibrils which converge upon the desmasomes of the prickles. These tonofibrils become more prominent toward the st. granulosum

### Stratum Lucidum

- Questionable fourth layer which is often so thin that it is sometimes considered not to be a transitional layer between the st. granulosum and the st. Corneum It is so thin that there is debate currently that the layer is an artefact of the electron microscope and doesn't in fact exist
- Supposedly most pronounced in the palms of the hands and the soles of the feet
- Cells show signs of disintegration and have lost their nuclei and organelles

### Stratum Corneum (Horny Layer)

- Final layer or the Horny layer
- Cells are non-nucleated disintegrated, fused, flattened squamous cells which are filled with Keratin fibres (matured Keratin)
- Little water
- Forms the protective barrier for the skin
- As the junctions become interrupted, the cells are desquamated

#### Dermis

Contains two layers

Papillary Layer which is closest to the Epidermis Reticular Layer

### Papillary Layer

Consists of loose connective tissue with fine Collagen and Elastin fibres Folded into ridges or papillae which extend in to the Epidermis Especially noticeable in the palms and soles (fingerprints) Contains nerve fibres and blood vessels which extend into the folds, supplying the Epidermis which is avascular Rete pegs (?)

### **Reticular Layer**

No defined boundary between the two layers Contains denser connective tissue and many thick Collagen fibres (Hypodermis) Technically not part of the skin Composed of loose connective tissue and contain lots of Adipose Tissue for metabolism, insulation,



### **EPIDERMIS: Cell types**



Nerve cell represented by its axon

### Skin, thick H&E

### dermal papillae

= epidermis

Contraction of the

### - dermis

hypodermis

a hander



### **THICK, HAIRLESS SKIN**



Most of your body is covered by a fairly thin cutaneous membrane, which has hairs growing from

it. This portion of the integumentary system is often called **hairy skin** (it may also be called

"thin skin").

The palms of your hands and the soles of your feet are covered with a thicker cutaneous membrane, which has no hairs.

This portion of the integumentary system is called

### thick skin.





### Desquamated superficial cells

Keratinized cell-

Desquamating superficial cells

> Keratohyalin granules



Keratinized epithelium

Stratified squamous epithelium

100 µm



### epidermis

1. The outermost layer of skin consisting of several layers of epithelial cells , keratinocytes ;and, in the inner layer of the epidermis, basal cells and melanocytes.

2. The outer layer of cells in the plant body, often covered by a waxy cuticle.





Stratum lucidum Stratum granulosum

Stratum spinosum

Stratum basale



### Layers of the Epidermis



Stratum Comeum

Stratum Granulosum

Stratum Spinosum Melanocyte Cell Basal Layer





# Epidermis

Stratum pasale

### Dermis

### stratum corneum

niosin

## stratum spinosum

Stannuclum

# stratum spinosum

1100000

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ALL REAL

Colling of the second





**dermis** One of the two layers of skin; a connective tissue layer under the epidermis containing elastic and collagen fibers, capillary networks, and nerve endings.

Papillary layer of dermis

Reticular layer
of dermis



The papillary dermis (**PD**) contains vascular networks that have two important functions. The first being to support the avascular epidermis with vital nutrients and secondly to provide a network for thermoregulation. The vasculature is organized so that by increasing or decreasing blood flow, heat can either be conserved or dissipated. The vasculature interdigitates in areas called dermal papillae (**DP**). The papillary dermis also contains the free sensory nerve endings and structures called Meissner's corpuscles in highly sensitive areas.

The integumentary system has multiple roles in:

- homeostasis,
- •including protection,
- •temperature regulation,
- sensory reception,
- •biochemical synthesis,
- and absorption.

All body systems work in an interconnected manner to maintain the internal conditions essential to the function of the body.

### Immunology of Skin Structures Epidermal barrier - innate immunity, protective barrier

### Cells

Langerhans cell Outermost immune cell Important role in antigen presentation

T lymphocyte Circulate through normal skin Different types are present Mast cell Normal residents of the Dermis Part of the inflammatory reaction Keratinocyte Have an immunological function Can produce pro-inflammatory Citokines

Can express immune reactive molecules & intercellular adhesion molecules

### **Functional Systems**

- Skin-associated Lymphoid Tissue
- Skin has a regulatory immunological function
- Blood, Lymphatic drainage, circulating Lymphocytes & resident immune cells
- Cytokines & eicosanoids
- Mediate inflammatory response as well as action between cells Complement
- Activation of a complement cascade of events in the inflammatory response eg. Lysis & Chemotaxis for Neutrophils & Macrophages

Adhesion molecules

Help bind T cells & increase cell trafficking to the area

### Immunogenetics

- Tissue type Antigens of an individual
- These Antigens are found in the major histocompatibility complex (MRC)
- MRC located on the HLA gene cluster on chromosome 6
- Vital for immunological recognition
- eg. Psoriasis is associated with the B13 HLA Antigen

### Hypersensitivity reactions and the Skin

- Inappropriate or exaggerated response where tissue damage results
- 4 types
- Type I (immediate)
- Type II (antibody-dependent cytotoxicity)
- Type III (immune complex disease)
- Type IV (cell mediated or delayed)

### **Hairy Skin**





100 µm



Epidermis

Sebaceous gland

Hair follicle

# hair

Skin, hairy H&E

inner and 4 outer root sheath \_ dermal sheath

bulb

hair



dermal papilla







# Hair follicles of terminal hair span the entire dermis and usually extend deep into the hypodermis.

Most of them will be cut at odd angles and only a few good longitudinally or transversely cut profiles are visible.

The hair may have been lost during the preparation of the specimen and not all hair follicles will contain hairs.

Although it is often possible to see the attachment of the arrector pili muscle into the hair follicle or the papillary layer of the dermis, both attachments are hardly ever visible in the same section.

### Hairy Skin trichrome

### Hairy Skin H&E

disintegrating sebum-containing secretory cells

hair canal

sebaceous gland

> intact sebum-containing secretory cells

### Slide 44 Skin

Hair shaft

Hair follicle

Hair follicle

Arrector pili muscle (smooth muscle) Sebaceous gland

Melanin granules

- Melanocyte









# Activity 1

- Of what type of tissue is the stratum basale made?
- Stratum germinativum or stratum basale is the layer of keratinocytes that lies at the base of the epidermis immediately above the dermis.
- 2. Of what type of tissue is the stratum granulosum made?
- It consists of a single layer of tall, simple columnar epithelial cells lying on a basement membrane
- 3. Which layer of the epidermis is the apical layer?

Keratin part [striatum corneum]



4. Which layer of the epidermis is in contact with the basement membrane? (Hint: refer back to Chapter 6 if you cannot remember what the basement membrane is.)Look your books for this one

6.Of what type of tissue is the papillary layer of the dermis made?

loose connective tissue,

The papillary layer lies directly beneath the epidermis and connects to it via papillae (finger-like projections).

Some papillae contain capillaries that nourish the epidermis; others contain Meissner's corpuscles, sensory touch receptors.

7. Of what type of tissue is the reticular layer of the dermis made?

dense connective tissue

contains criss-crossing collagen fibers that form a strong elastic network.

This network forms a pattern called cleavage (Langer's) lines.

the reticular layer also contains Pacinian corpuscles, sensory receptors for deep pressure This layer contains sweat glands, lymph vessels, smooth muscle, and hair follicles

8. Of *all* the sub-layers of the cutaneous membrane, which is the thickest in thick skin?

- 8. Why is it important that the stratum corneum of thick skin is thicker than the stratum corneum of hairy skin? (Hint: Recall where thick skin is located.)
- Protection,
- Several layers of cells containing keratohyalin granules are visible in thick skin.
- 10. How many total sub-layers of the epidermis and dermis are found in hairy skin?
- 11. List all of the different types of tissue found in the layers that make up the cutaneous membrane of hairy skin.

# To resume

Epidermis: Stratified squamous cornified epithelium of the skin.

**Dermis:** Connective tissue layer beneath the epidermis. Its thickness varies in different parts of the body. It is rich in collagenous and elastic fibers. The part of the dermis underlying the epithelium is called the papillary layer. The deeper part is the reticular layer, in which sebaceous glands are found. In addition, hair follicles, sweat glands, and Pacinian corpuscles occur in this layer. In the face, the striated muscles of facial expression terminate in the dermis.

**Sebaceous gland:** Holocrine variety of gland in which the entire cell is lost along with the secretory products. Intimately associated with hair follicles into which they drain. Composed of a group of saclike alveoli ensheathed by a thin layer of connective tissue. The alveoli are composed of stratified cuboidal or polyhedral epithelia[ cells that fill the sac. The secretion of the sebaceous gland is an oily substance (sebum) that lubricates the epidermis and hair.

**Sebaceous gland cell:** Note the peripheral, small cuboidal cells and the more central, larger polyhedral or spheroidal cells. Oily droplets increase with an increase in size of the cells. See <u>Plate 83</u>.

**Nucleus:** Nuclei of peripheral cells are rounded. Nuclei of centrally located cells are either shrunken or absent. This nuclear change is part of the degenerative process by which the entire cell is lost, along with its secretion product.

**Hair follicle:** Surrounds the hair shaft and is composed of inner epidermal epithelial elements and outer dermal connective tissue elements.

**Hair shaft:** Located within the follicle. The free end of the hair projects from the surface of the skin.



<sup>20</sup> µm



#### Stratum corneum

#### Stratum Malpighii

**Stratum Malpighii:** Mitotic cell division occurs in this layer. Desmosomes join adjacent cells. Prominent nuclei with small dark nucleoli. Nuclear staining characteristics indicate that these nuclei are functionally active.





thoracic vertebral segmentation defects. In the lumbar region, increased interpediculate distance, flattening of the vertebral bodies and narrowing of the intervertebral spaces, as well as the presence of a calcified "spur" on the lateral view were consistent with diastematomyelia. Ultrasound showed a split cord.