INTEGUMENT

Dr. Larry Johnson
Objectives

• Distinguish between the 5 layers of epidermal cells in thick skin and the differences in these found in thin skin.

• Describe the organization of the two layers comprising the dermis.

• Detail the structure of the sebaceous gland, eccrine sweat gland, and apocrine sweat gland.

• Recognize melanin and its functional significance.

From: Douglas P. Dohrman and TAMHSC Faculty 2012 Structure and Function of Human Organ Systems, Histology Laboratory Manual
BINARY ORIGIN OF SKIN

EPIDERMIS – ECTODERM
BINARY ORIGIN OF SKIN

EPIDERMIS – ECTODERM

DERMIS – MESODERM
Functions of skin

PROTECTS AGAINST INJURY AND DESICCATION
MAINTENANCE OF WATER BALANCE
Functions of skin

PROTECTS AGAINST INJURY AND DESICCATION
MAINTENANCE OF WATER BALANCE
EXCRETES VARIOUS SUBSTANCES
Functions of skin

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MAINTENANCE OF WATER BALANCE
EXCRETES VARIOUS SUBSTANCES
THERMOREGULATION
Functions of skin

PROTECTS AGAINST INJURY AND DESICCATION
MAINTENANCE OF WATER BALANCE
EXCRETES VARIOUS SUBSTANCES
THERMOREGULATION
RECEIVES STIMULI
  • TEMPERATURE
  • PAIN
  • PRESSURE
Functions of skin

PROTECTS AGAINST INJURY AND DESICCATION
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BASIS OF RECOGNITION AND YIELDS CLUES TO ONE’S WELL BEING
Functions of skin

PROTECTS AGAINST INJURY AND DESICCATION
MAINTENANCE OF WATER BALANCE
EXCRETES VARIOUS SUBSTANCES
THERMOREGULATION
RECEIVES STIMULI
- TEMPERATURE
- PAIN
- PRESSURE
BASIS OF RECOGNITION AND YIELDS CLUES TO ONE’S WELL BEING
FAT METABOLISM IN THE SUBCUTANEOUS LAYER
## Integument

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>THICK SKIN</th>
<th>THIN SKIN</th>
</tr>
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<tbody>
<tr>
<td>Surface Texture</td>
<td>Alternating ridges and grooves</td>
<td>Smooth</td>
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<tr>
<td>Epidermis/Dermis Interface</td>
<td>Interdigitating ridges</td>
<td>Less prominent ridges</td>
</tr>
<tr>
<td>Epidermal Strata</td>
<td>• S. Basale</td>
<td>• Same as thick skin, except: no S. Lucideum.</td>
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<tr>
<td></td>
<td>• S. Spinosum</td>
<td>• The corneum, granulosum, and spinosum layers are reduced in thickness.</td>
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<tr>
<td></td>
<td>• S. Granulosum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• S. Lucidum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• S. Corneum</td>
<td></td>
</tr>
<tr>
<td>Hairs and Sebaceous Glands</td>
<td>None</td>
<td>Regionally variable</td>
</tr>
<tr>
<td>Sweat Glands</td>
<td>Abundant</td>
<td>Moderate</td>
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</tbody>
</table>
REGIONAL VARIATION OF THE EPIDERMIS

THICK SKIN - SOLE OF FOOT (1.4 mm THICK)

THIN SKIN - EYELID AND MOST OF BODY (0.07 TO 0.12 mm)

CORNEA OF EYE - TRANSPARENT

APPENDAGES - HAIR FOLLICLES

NAILS

GLANDS
REGIONAL VARIATION OF THE EPIDERMIS
Slide 29: Thick Skin (ventral surface of finger)
Slide 29: Thick Skin (ventral surface of finger)

- Epidermis
- Dermis
- Papillary layer
- Reticular layer
- Dermal papillae
- Epidermal peg
Dermal side
of the Epidermal – dermal interface
Meissner’s corpuscles in dermal papillae

Meissner’s corpuscle is a mechanoreceptor nerve ending for sensitivity to light touch; you would find more on your fingers because they are more sensitive to touch than your elbow.
Skin hand monkey

Hypodermis

Reticular layer

Papillary layer

Dermal papillae

Epidermal peg
Skin hand monkey

Eccrine sweat glands

Adipocytes

Pacinian corpuscles

Hypodermis

Reticular layer

Papillary layer

Dermal papillae

Epidermal peg
Obesity is characteristic of having a thickened subcutaneous layer.
LAYERS OF THE EPIDERMIS: PALMS AND SOLES OF FEET

STRATUM CORNEUM

• KERATINIZED FLATTENED, DENUCLEATED, DEAD CELLS
LAYERS OF THE EPIDERMIS: PALMS AND SOLES OF FEET

STRATUM CORNEUM
• KERATINIZED FLATTENED, DENUCLEATED, DEAD CELLS

STRATUM GRANULOSUM
• KERATOHYALIN GRANULES
LAYERS OF THE EPIDERMIS: PALMS AND SOLES OF FEET

STRATUM CORNEUM
- KERATINIZED FLATTENED, DENUCLEATED, DEAD CELLS

STRATUM GRANULOSUM
- KERATOHYALIN GRANULES

STRATUM SPINOSUM
- TONOFIBRILS - DESMOSOMES
LAYERS OF THE EPIDERMIS: PALMS AND SOLES OF FEET

STRATUM CORNEUM
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STRATUM GRANULOSUM
- KERATOHYALIN GRANULES

STRATUM SPINOSUM
- TONOFIBRILS - DESMOSOMES

STRATUM BASALE
- CONTINUAL RENEWAL OF EPIDERMIS
Slide 29: Thick Skin (ventral surface of finger) cont.

1. Stratum corneum
2. Stratum lucidum
3. Stratum granulosum
4. Stratum spinosum
5. Stratum basale

- Keratohyalin granules
- Desmosomes
- Hemidesmosomes
S. granulosum: flattened cells undergoing the terminal differentiation process of keratinization – forming the skin’s barrier against water loss when sealed with contents of membrane coating granules.
The epidermis of thick skin is subject to continuous friction and pressure so the abundant desmosomes (and tonofibrils) withstand this and hold the cell layers together.
STRATUM SPINOSUM
STRATUM SPINOSUM
1. Stratum corneum
2. Stratum granulosum
3. Stratum spinosum
STRATUM CORNEUM
STRATUM CORNEUM
Cells in EPIDERMIS

STRATIFIED SQUAMOUS - CELL TYPES INCLUDE:

KERATINOCYTES - MAIN CELL TYPE – ECTODERM
MELANOCYTES - PIGMENTATION - NEURAL CREST
LANGERHANS CELL - IMMUNOLOGIC ROLE
MERKEL CELLS - ASSOCIATED WITH NERVE ENDINGS
The embryonic origin of melanocytes is the neural crest derivatives that migrate into the embryonic epidermis’ stratum basale.
MELANOCYTE - PIGMENT SYNTHESIS

MELANOGENESIS

CYTOCRINE SECRETION - PASS MELANIN GRANULES TO KERATINOCYTES
CYTOCRINE SECRETION - PASS MELANIN GRANULES FROM MELANOCYTES TO KERATINOCYTES
MELANOCYTE - PIGMENT SYNTHESIS

LOCATED IN THE STRATUM BASALE
CLEAR CELL - NO DESMOSOMAL CONNECTION
Slide 31: Thin Skin (scalp)

- **Stratum corneum**
- **Stratum granulosum**
- **Stratum spinosum**
- **Stratum basale**
Slide 31: Thin Skin (scalp)

- **Stratum basale**
- **Stratum spinosum**
- **Stratum granulosum**
- **Stratum corneum**

**Melanin capping of nuclei**
Slide 31: Thin Skin (scalp)

- **Stratum basale**
- **Stratum spinosum**
- **Stratum granulosum**
- **Stratum corneum**

- Melanin capping of nuclei

Sun from NASA

Melanin capping of nuclei
Melanocytes respond to melanocyte stimulating hormone secreted by the pars intermedia. 

Melanin granule accumulate over the nuclei of mitotic cells of the stratum basale to protect nuclear DNA from UV damage.
MELANOCYTE - PIGMENT SYNTHESIS

SUSCEPTIBLE TO HORMONES AND PHYSICAL FACTORS

• SUN-TANNING

• SEX DIFFERENCES

• PREGNANCY
MELANOCYTE DENSITY - SIMILAR IN ALL HUMANS
MELANOCYTE DENSITY - SIMILAR IN ALL HUMANS
MELANOCYTE - PIGMENT SYNTHESIS

FRECKLES - MELANIN DISTRIBUTED IN PATCHES
MELANOCYTE – disease states

ALBINISM - FAILURE TO PRODUCE MELANIN

MALIGNANT MELANOMAS - CANCER

ADDISON’S DISEASE - PIGMENT DEPOSITION IN SKIN DUE TO ADRENOCORTICAL INSUFFICIENCY
LANGERHANS CELLS

BONE MARROW ORIGIN
LOCATED IN STRATUM SPINOSUM - GOLD CHLORIDE STAIN

CLEAR CELL - NO DESMOSOMES
DENDRITIC CELL
LANGERHANS CELLS

DENDRITIC CELL
ROD OR RACKET
SHAPED GRANULES

FUNCTION -
IMMUNOLOGIC ROLE AS
AN ANTIGEN-
PRESENTING CELL

CONTACT ALLERGIC
RESPONSES AND
OTHER CELL MEDIATED
REACTION OF THE SKIN
Epidermal – dermal interface
Epidermal – dermal interface

Underside of epidermis showing « rete » ridges and between them cavities into which the corium papillae fit

Dermis with large ridges on which we find many papilla
MELANIN is produced by MELANOCYTES
MELANIN-producing enzymes in MELANOCYTES

Space of removed dermis

EPIDERMIS
Epidermal - dermal interface
Epidermal - dermal interface
- finger pad
Epidermal – dermal interface finger pad
Skin, foot
Epidermal – dermal interface creates unique finger ridges
A ridge pattern may occur on any finger. Two of the pattern names, radial and ulnar, refer to the loops in relation to bones in the arm, the radius and the ulna. (The radius is on the thumb side.)

Creases in the palm are of interest to science; specifically, the simian fold (not shown here) is a sign of Down's syndrome. Oddly enough, Down's seems to be related to Alzheimer's disease (a form of senility); fingerprint patterns are sometimes used to confirm a diagnosis of Alzheimer's disease.

Micrographs of skin from other parts of the body show patterns very different from the ridges found on the hands and the feet.

- Skin pattern on an earlobe.
- Surface of skin on lower lip.
Slide 30: Thick Skin (Pacinian corpuscle and melanin)
Pacinian corpuscles are mechanoreceptors that detect vibration and pressure.
Pacinian corpuscles are mechanoreceptors that detect vibration and pressure.
Skin, scalp
Slide 31: Thin Skin (scalp)

- Hair follicle location
- Arrector pili muscle
- Sebaceous glands
Skin, scalp
Skin, scalp

sebaceous glands
Mode of secretion of the sebaceous glands is holocrine where by the sebum is released when cells burst.
Mode of secretion of the sebaceous glands is holocrine where the sebum is released when cells burst.
Eccrine sweat glands
Slide 66: Recto-anal junction

- Sebaceous gland
- Hair follicle
- Eccrine sweat glands
Simple columnar epithelium of rectum with goblet cells

Stratified squamous epithelium of anal wall
Slide 66: Recto-anal junction

- Sebaceous gland
- Apocrine sweat gland
- Hair
MECHANISM FOR RELEASE OF SECRETORY PRODUCTS

MEROCRINE SECRETION – EXOCYTOSIS W/O LOSS OF SURFACE MEMBRANE
MECHANISM FOR RELEASE OF SECRETORY PRODUCTS

MEROCRINE SECRETION – EXOCYTOSIS W/O LOSS OF SURFACE MEMBRANE

APOCRINE SECRETION – LOSS OF PART OF APICAL CYTOPLASM AND SOME PLASMA MEMBRANE
MECHANISM FOR RELEASE OF SECRETORY PRODUCTS

MEROCRINE SECRETION – EXOCYTOSIS W/O LOSS OF SURFACE MEMBRANE

APOCRINE SECRETION – LOSS OF PART OF APICAL CYTOPLASM AND SOME PLASMA MEMBRANE

HOLOCRINE SECRETION – RELEASE OF WHOLE CELL
OTHER GLANDS OF EPIDERMAL ORIGIN

SWEAT GLANDS

- ECCRINE - COMMON SWEAT GLAND - LOCAL COOLING

- APOCRINE AXILLARY REGION - FUNCTION IN ANIMALS
SWEAT GLANDS secretions
SWEAT GLANDS secretions
Myoepithelial cells are eosinophilic because of the presence of muscle contractile proteins, which contract to expel sweat when needed.

Thick Skin (ventral surface of finger)

- Eccrine sweat glands
- Myoepithelial cells
- Ducts of eccrine sweat glands with stratified cuboidal epithelium
- Eccrine sweat glands
Functional diversity of skin

- Protects against injury (e.g., UV light or mechanical stresses) and desiccation
- Maintenance of water balance
- Excretes
- Thermoregulation
- Receives stimuli
- Fat metabolism
THREE TYPES OF GRANULES IN KERATINOCYTES

MELANIN
- Skin pigment
- Produced by melanocytes and passed by cytocrine secretion to keratinocytes

MEMBRANE COATING GRANULES (LAMELLATED GRANULES)
- Water proofing function
- Produced by keratinocytes

KERATINOHYALIN GRANULES
- Produced by keratinocytes
THREE TYPES OF GRANULES IN KERATINOCYTES

MEMBRANE COATING GRANULES (LAMELLATED GRANULES)

- Small, ovoid structures from the Golgi containing various lipids and they undergo exocytosis to produce a lipid-rich impermeable layer around the cells of the s. granulosum – water proofing.
THREE TYPES OF GRANULES IN KERATINOCYTES

KERATINOHYALIN GRANULES
- CHEMICAL NATURE NOT CLEARLY ESTABLISHED
- RICH IN HISTODINE FORMS
- MATRIX OF CELLS IN STRATUM CORNEUM, STABILITY DUE TO DISULFIDE BONDS
- ABSENT IN HAIR AND NAILS
Regeneration of epidermis
Degrees of Burn, Methods of Treatment

The three burn categories correspond to the three layers of skin. A first-degree burn damages only the outer layer, the epidermis. A second-degree burn penetrates deeper, into the dermis. Capillaries may be damaged, and plasma may escape to produce blistering—and great pain. In third-degree burns, the damage reaches the subcutaneous layer. This kind of burn is dangerous because the slow-healing underskin is vulnerable to bacterial attack. Loss of blood may impede circulation and cause dehydration.

First-degree burns, such as scalds, affect the outer skin and heal by themselves. Cold water gives relief.

Second-degree burns damage the lower layer. If blisters are unbroken, they protect the injured area.

Third-degree burns, which go into the subcutaneous layer, should receive immediate medical attention.
Albinism can be caused by a hereditary defect in tyrosinase activity or the inability of cells to take up tyrosine.

Patient with albinism would be more at risk for the development of basal and squamous cell carcinomas as albinism produces skin hypopigmentation so fewer melanin granules to protect nuclear DNA from the ionizing, mutagenic effects of UV radiation.
Many illustrations in these VIBS Histology YouTube videos were modified from the following books and sources: Many thanks to original sources!

The End!