Medical School Histology Basics
Integumentary System

VIBS 289 lab

Larry Johnson  Texas A&M University
Objectives

To gain a greater appreciation of the **diversity of functions** of skin

To recognize the different **cell types and structures** of the skin which make possible this functional diversity
Functions of Skin:

- Protects against injury
- Protects against desiccation and allows terrestrial existences
- Maintenance of water balance
- Excretes/secretes 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
BINARY ORIGIN OF SKIN

EPIDERMIS – ECTODERM

DERMIS - MESODERM

Thin skin
Skin

Epidermis

Dermis

Thin skin
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
Epidermis gives rise to numerous appendages

- Hair follicles
- Breast (Mammary gland)
- Tarsal gland of eyelid
- Apocrine sweat
- Slide Histo66
- Recto-anal junction
- Nails
- Tears
Location of thin and thick skin and layers of skin

Structures in skin

Use your ATLAS for orientation
Abdominal skin is the least specialized and most prototypic of skin in general (Slide 206). The dermis is dense irregular connective tissue.
Slide Histo 029: Thick Skin (ventral surface of finger)
Slide 029: Thick Skin (ventral surface of finger)

Papillary layer

Reticular layer

Dermal papillae

Epidermal peg

Dermis

Epidermis

Papillary layer

Reticular layer
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

- Eccrine sweat glands
- Adipocytes
- Pacinian corpuscles
- Reticular layer
- Papillary layer
- Dermal papillae
- Epidermal peg
105  Fingertip, monkey - sweat glands and ducts among Pacinian corpuscles

Eccrine sweat glands

Duct of sweat glands

Pacinian corpuscle
LAYERS OF THE EPIDERMIS: PALMS AND SOLES OF FEET

STRATUM CORNEUM
- KERATINIZED
  FLATTENED,
  DENUCLEATED, DEAD
  CELLS

STRATUM GRANULOSUM
- KERATOHYALIN
  GRANULES

STRATUM SPINOSUM
- TONOFIBRILS -
  DESMOSOMES

STRATUM BASALE
- CONTINUAL RENEWAL
  OF EPIDERMIS
Slide 029: Thick Skin (ventral surface of finger) cont.

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

- Duct of sweat gland
- Keratohyalin granules
- Desmosomes
- Hemidesmosomes

Microscopic View:
- Stratum basale
- Stratum spinosum
- Stratum granulosum
- Stratum lucidum
- Stratum corneum
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 CORNEUM
Slide 31: Thin Skin

EM 8g of skin

- Stratum corneum
- Stratum granuloseum
- Long processes of Langerhans cells
- Desmosome
- Keratinocytes
- Stratum spinosum
- Stratum basale
Cells in EPIDERMIS

The epidermis is classified as STRATIFIED SQUAMOUS epithelium –

CELL TYPES INCLUDE:

KERATINOCYTES - MAIN CELL TYPE – ECTODERM
MELANOCYTES - PIGMENTATION - NEURAL CREST
LANGERHANS CELL - IMMUNOLOGIC ROLE
MERKEL CELLS - ASSOCIATED WITH NERVE ENDINGS
CYTOCRINE SECRETION - PASS MELANIN GRANULES FROM MELANOCYTES TO KERATINOCYTES
MELANIN-producing enzymes in MELANOCYTES
Stratum corneum
Stratum granulosum
Stratum spinosum
Stratum basale

Melanin capping of nuclei
Thin Skin 31 (scalp)

Melanin capping of nuclei

Sun from NASA
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
Epidermal – dermal interface finger pad
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.
sebaceous glands
arrector pili muscle
pilosebaceous units
vascularized dermal papillae
Slide 31: Thin Skin (scalp)

- Hair follicle location
- Arrector pili muscle
- Sebaceous glands
Skin, scalp
Mode of secretion of the sebaceous glands is holocrine where by the sebum is released when cells burst.
Eccrine sweat glands
epidermis

stratum corneum

Openings of ducts of 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

**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
Myoepithelial cells are eosinophilic because of the presence of muscle contractile proteins, which contract to expel sweat when needed.
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.
Dermis

Elastic fibers
   - Network between collagen bundles muscle

Smooth muscle - loose plexus in reticular layer in areolae, penis, perineum, and scrotum
Dermis

Muscle

- Smooth muscle – hair follicles
- Skeletal muscle - terminated in the dermis
  - Facial expression

Also, hair follicles, glands, blood vessels, nerves, and nerve endings abound
Dermis

Muscle
Skeletal muscle - terminated in the dermis
• Facial expression
Slide #83 (SP-1-79). Skin of lip, sheep.

NONKERATINIZED STRATIFIED SQUAMOUS [EPITHELIUM]

KERATINIZED STRATIFIED SQUAMOUS [EPITHELIUM]

oral cavity

skin adnexa (i.e., hair/hair follicles, sebaceous & sweat glands, arrector pili muscles)
Tongue, monkey
Epidermal and Dermal – nerve Interfaces

Free nerve endings, which are scattered throughout the body, and which are grouped around the bases of hairs, can register pain and pressure. Other, larger specialized receptors are also present (see above). These occur in clusters, the more numerous, the more sensitive the area. The tips of the fingers have many...
Clinical Correlation

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.

[Tyrosine amino acid figure](http://chemistry.about.com)

[Albino peacock](http://www.duskywondersite.com/animals/albino-animals/)
Many illustrations in these VIBS Histology YouTube videos were modified from the following books and sources: Many thanks to original sources!

- Douglas P. Dohrman and TAMHSC Faculty 2012 Structure and Function of Human Organ Systems, Histology Laboratory Manual - Slide selections were largely based on this manual for first year medical students at TAMHSC
In summary

Functions of Skin: Functional Diversity of Skin

- Protects against injury and desiccation
- Maintenance of water balance
- Excretes/secretes 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
Questions Integumentary System

1. Which layer of the epidermis has **meiotic** activity?
   a. stratum basale  
   b. stratum spinosum  
   c. stratum granulosum  
   d. stratum corneum  
   **e. none of the above**

2. Which of the following skin granule - function(s) match(es)?
   a. melanin - skin pigment  
   b. membrane coating granules - waterproofing  
   c. keratinohyalin granules - forms junctions between adjacent cells  
   **d. a and b**  
   e. a, b, and c

3. Which function(s) of skin involve(s) granules:
   a. protection against ultraviolet light  
   b. protection against mechanical injury as granules form matrix of cells in stratum corneum  
   c. protection against desiccation  
   **d. a and b**  
   **e. a, b, and c**

4. The dermis:
   a. has muscle (smooth and/or skeletal)  
   b. has elastic fibers that are reduced with age  
   c. has a **reticular layer** that interacts with/has direct contact with the epidermis  
   **d. a and b**  
   e. a, b, and c
In the last 15 years, I promoter STEM to over 35,000 middle and high school students and their teachers.

Our Youth STEM-promotion website is [http://peer.tamu.edu](http://peer.tamu.edu) received over 8,000,000 hits last year alone.
The end of

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