

# Lab 5

## Integumentary System

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### **Skin:**

- The skin is the largest single organ of the human body accounting for about 15% of total body weight.
  - The skin is organized into various layers and varies in thickness based on location and use. Knowing the sequence of the skin layers is very critical to recognizing them on slides. Some layers are very thin, and may not always be present on a slide (they are discontinuous). Also, the Stratum Lucidum is only present in Thick Skin locations. From superficial to deep the layers of skin are:
    - **Epidermis**
      - **Stratum Corneum**
      - **Stratum Lucidum** → (only seen in Thick Skin)
      - **Stratum Granulosum**
      - **Stratum Spinosum**
      - **Stratum Basale**
    - **Dermis**
      - **Papillary Layer of the Dermis**
      - **Reticular Layer of the Dermis**
    - **Hypodermis**
  - The basic functions of the skin are:
    - **Physical Barrier for Protection** against:
      - Friction forces
      - Temperature changes
      - Pathogen entry
      - Ultraviolet (UV) radiation damage to nuclei
      - Permeability Barrier blocking excessive loss or gain of Water and non-lipophilic chemicals.
    - **Sensory Innervation:**
      - Many types of sensory receptors to process touch, vibration, temperature, pressure, stretch, and pain.
    - **Thermoregulation:**
      - Can regulate and help maintain a constant, stable internal body temperature via negative feedback. This is done by varying the amount of blood flow into the dermis (remember, blood transports heat), and varying the amount of sweat production (sweat also transports heat).
    - **Metabolic:**
      - Keratinocytes exposed to UV light can form vitamin D<sub>3</sub>. Vitamin D<sub>3</sub> is needed for proper calcium metabolism and bone formation.
      - Like the kidneys, excessive electrolytes and metabolic waste products can be excreted in the sweat.
      - The adipose loose connective tissue (fat) stores energy.
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□ Cells & Structures found in the Epidermis:

□ **Keratinocytes**

- about 90% of the cells seen in the epidermis.
- these cells are found in all layers of the epidermis.

□ **Melanocytes**

- these cells are primarily in the **Stratum Basale**.
- produce **melanin** pigments when exposed to **UV light**.
- melanin pigments are packaged into vesicles called **melanosomes** and released by exocytosis.
- neighboring keratinocytes pick up the melanosomes by endocytosis and position them on the “*sunny side*” of their *nucleus* to shield the DNA from UV light damage.
- the size, number, arrangement, and productivity of these cells varies between races, and UV light exposure.

□ **Langerhans Cell**

- these cells are primarily in the **Stratum Spinosum**.
- they are a type of “*antigen-presenting*” immune system cell.
  - Langerhans cells recognize, endocytose, digest, and present pieces of the foreign substances to other white blood cells.
- visibly they will look like the surrounding keratinocytes, but can be seen with special histologic staining techniques.
- they are dendritic-shaped (spidery-shaped) cells that have dark staining “*tennis-racket*” shaped organelles called **Birbeck Granules**, which may be visible.
  - the function of Birbeck Granules is still unknown.

□ **Merkel Cell**

- These “clearish” cells are primarily in the **Stratum Basale**.
- also called “Merkel-Ranvier” cells or “Tactile Epithelial” cells.
- found in high numbers in fingers tips, palms, and feet near the bottom of epidermal invaginations.
- each Merkel cell is about 10 µm in diameter.
- reacts best to low vibrations (5 – 10 Hz) & “deep static” touch, such as feeling shapes and edges of objects.
  - *Merkel* cells can respond to continuous pressure over long period of time.
  - each Merkel cell has a very small receptive field, but is able to discern very high levels of detail when large numbers of cells are located in small area such as the fingertips..
- *special histologic stain need to distinguish from Melanocytes..*
  - *It is usually not possible to see the nerve connecting to the Merkel Cell.*

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**Slide 1-7-1 Thick Skin:**

- **Epidermis**
  - Is made of **Keratinized, Stratified Squamous Epithelium.**
  - **Stratum Corneum**
    - Very thick, usually many layers of dead cells and keratin fibers present here.
    - Some areas will look very flaky and detached, with air gaps.
    - easily rubbed off with friction forces.
  - **Stratum Lucidum**
    - looks “blue” due to the compressed dead cells and keratin fibers present here.
    - may be missing in some areas (discontinuous layer).
  - **Stratum Granulosum**
    - may be missing in some areas (discontinuous layer).
    - usually 2 or more cells thick.
    - cells are alive, but appear “granular”.
  - **Stratum Spinosum**
    - thick layer of keratinocytes with some Langerhans cells.
    - keratinocytes in this layer also called “prickle cells”.
      - *“spiky” look of cells of is due to the slide preparation techniques that cause the desmosomes linking neighboring keratinocytes to hold tight while the rest of the cell shrinks some.*
  - **Stratum Basale**
    - also called the “*Stratum Germinativum*” because of the high rate of mitosis here.
      - new keratinocytes made here migrate upward to the Stratum Spinosum.
    - single row of cells, and lowest layer of the epidermis.
      - most cells are keratinocytes.
      - 10% to 25% are melanocytes.
      - Merkel cells are located in the Stratum Basale layer.
      - some Langerhans cells are here (most are in the Stratum Spinosum).
- **Dermis**
  - overall thicker layers present in thick skin locations.
  - this layer has blood vessels & nerves passing through it.
  - **Papillary Layer of the Dermis**
    - is made of **Areolar Loose Connective Tissue.**
    - **Meissner’s Corpuscles** (see slide 1-7-4).
  - **Reticular Layer of the Dermis**
    - is made of **Dense Irregular Connective Tissue.**
    - structures located here.
      - *NO HAIR is usually seen in thick skin locations.*
      - **Pacinian Corpuscles** (see slide 1-7-3).
      - **Eccrine Sweat Glands & Apocrine Sweat Glands.**
      - larger blood vessels the deeper you go.
- **Hypodermis**
  - also known as the “**Superficial Fascia**”.
  - is made of **Adipose Loose Connective Tissue.**

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## **Slide 1-7-2 Thin Skin:**

\*Lack of the Stratum Lucidum layer, and a discontinuous, very thin Stratum Granulosum are key visual features. Also look for an overall thinner Stratum Corneum and Stratum Spinosum (usually just a few cells thick). Most of your skin is thin.

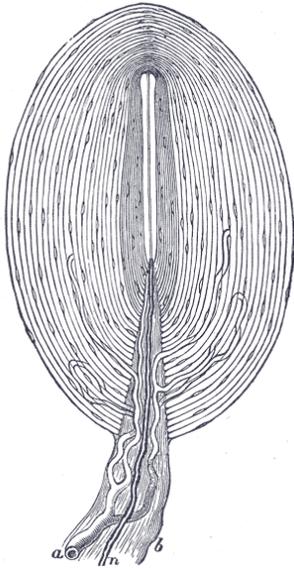
Thin Skin layers to visualize in order from Superficial to Deep:

- **Epidermis**
    - Is made of **Keratinized, Stratified Squamous Epithelium**.
    - **Stratum Corneum**
      - Very thin, usually just a few layers of keratin protein fibers.
      - Is the keratinized (dead) part of the epithelium.
      - easily rubbed off with friction forces.
    - **Stratum Granulosum**
      - commonly missing in many spots (discontinuous layer).
      - usually just 1 or 2 cells thick.
      - cells are alive, but appear “granular”.
    - **Stratum Spinosum**
      - very thin layer of keratinocytes with some Langerhans cells.
      - keratinocytes in this layer also called “prickle cells”.
        - *“spiky” look of cells of is due to the slide preparation techniques that cause the desmosomes linking neighboring keratinocytes to hold tight while the rest of the cell shrinks some.*
    - **Stratum Basale**
      - also called the “*Stratum Germinativum*” because of the high rate of mitosis here.
        - new keratinocytes made here migrate upward to the Stratum Spinosum.
      - single row of cells, and lowest layer of the epidermis.
        - most cells are keratinocytes.
        - 10% to 25% are melanocytes.
        - Merkel cells are located in the Stratum Basale layer.
        - some Langerhans cells are here (most are in the Stratum Spinosum).
  - **Dermis**
    - overall thinner layers present in thin skin locations.
    - this layer has blood vessels & nerves passing through it.
    - **Papillary Layer of the Dermis**
      - is made of **Areolar Loose Connective Tissue**.
      - **Meissner’s Corpuscles** (see slide 1-7-4).
    - **Reticular Layer of the Dermis**
      - is made of **Dense Irregular Connective Tissue**.
      - structures located here.
        - **Hair root** (see slide 1-7-5)
        - **Pacinian Corpuscles** (see slide 1-7-3).
        - **Eccrine Sweat Glands & Apocrine Sweat Glands**.
        - larger blood vessels the deeper you go.
  - **Hypodermis**
    - also known as the “**Superficial Fascia**”.
    - is made of **Adipose Loose Connective Tissue**.
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**Slide 1-7-3 Pacinian (Lamellar) Corpuscle:**

□ **Pacinian Corpuscle**



Sketch by H.V. Carter (Gray's Anatomy, 1918 edition).

- a* artery
- n* nerve
- b* fibrous tissue of the stalk of the Pacinian Corpuscle

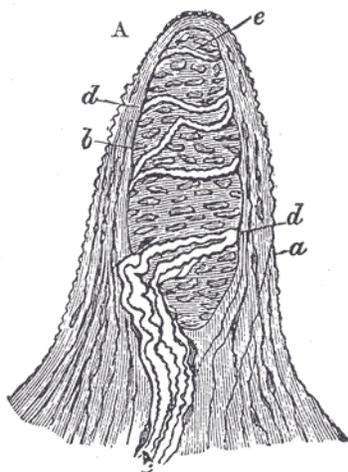
— also called “**Lamellar Corpuscle**”.

- are found in the **reticular layer of the dermis**.
  - more of them are found in the fingertips.
  - are made of about 20 to 60 concentric lamellae.
  - whole structure is about 1 mm in length and *looks like a “cut onion”* on the slide.
- most sensitive to “vibrations” and sudden pressure changes.
- are “rapidly adapting” (phasic) mechanoreceptors.
  - optimal sensitivity is 250 Hz, and allows the perception of fine texture features smaller than 1  $\mu\text{m}$  !!
  - large receptive field allows them to feel changes even a few centimeters away !!

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**Slide 1-7-4 Meissner's (Tactile) Corpuscle:**

□ **Meissner's Corpuscles**



Sketch by H.V. Carter (Gray's Anatomy, 1918 edition).

- a* cortical layer
- b* Meissner's Corpuscle
- d* nerve axons spiraling around the corpuscle.
- e* end of one of the nerves.

— also called “**Tactile Corpuscles**”.

- are found in the **papillary layer of the dermis** within the dermal papillae.
- rapidly adapting “light touch” mechanoreceptors.
- highest concentrated numbers found on the fingertips & lips.
- highest sensitivity for vibrations between a range of 10 Hz to 50 hertz.
- about 30  $\mu\text{m}$  to 140  $\mu\text{m}$  long (tall).
- about 40  $\mu\text{m}$  to 60  $\mu\text{m}$  wide.
- Age-related sensitivity of your fingers drops with age. The number of Meissner's Corpuscles in the fingertips drops four-fold between the ages of 12 and 50.

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## Slide 1-7-5 Hair Follicles:

\*Slides are of the dermis of thin skin and cut to show the longitudinal arrangement of the hair root. The **pilosebaceous unit** is made up of three structures: The hair follicle, the sebaceous gland, and the arrector pili muscle. These slides usually only contain good views of the **hair root for Terminal Hair**, and for that reason the structures listed below are limited to what can be seen.

- **Hair Shaft**
  - The part of a hair protruding from the skin. (Not on the slides).
  
- **Hair Root**
  - The part of a hair anchored in the skin.
  - most go as deep as the reticular layer of the dermis, but some hair roots can be seen reaching as deep as the hypodermis.
  
- **Hair Cuticle**
  - the surface of the hair cortex resembling roof shingles.
  - when covered in hair product (e.g., conditioner, gel) the gaps are smoothed out and the hair appears “shiny”.
  
- **Hair Cortex**
  - the outer part of the hair, where most of the color is located.
  
- **Hair Medulla**
  - the center of the hair, which gives it its thickness.
    - **Terminal hairs**, such as those on your head, eyebrows, armpits, and groin have thicker Hair Medullas.
    - **Vellus hairs**, such as those on a baby’s body, or the tiny hairs on your fingers have very little or no Hair Medulla.
      - *vellus* is Latin for “fleece” or “wool”.
      - also called “*peach fuzz*” now a days.
      - this is NOT the same as the thicker **Lanugo Hair** that grows on a fetus.
  
- **Hair Bulb**
  - the swollen (round) part of the hair root at the bottom.
  - contains the Hair Papilla inside of it.
  
- **Hair Papilla**
  - The “bump” of tissue within the hair bulb that contains the:
    - Blood vessels.
    - Nerve Endings.
    - **Hair Matrix** cells on the surface of the Hair Papilla:
      - specialized cells that grow the hair.
      - make a **hard keratin** protein, which contains a higher content of the amino acid cysteine.
      - some are **melanocytes** that make melanin pigments to color the hair.
  
- **Arrector Pili Muscle**
  - **smooth muscle** attaching the hair root the surrounding collagen fibers in the dermis.
  - *\*\*\*best seen on the hair models in the lab.*
  - contraction stimulated by the **sympathetic nervous system**.
    - Forms “goose bumps” on the skin surface.
    - Causes hair to “stand erect”.
    - Contraction may help sebum to exit sebaceous glands.

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## **Nails:**

\*Look at your own nails and a photo or sketch of a cross-section of the nail bed.

- **Nail Plate**
  - made of **Hard Keratin** proteins (like hair is)
    - Fingernails grow about 3.5 mm per month.
    - Toenails grow slower... about 1.6 mm per month.
    - Nails do NOT grow after death, but the surrounding skin dehydrates & tightens, making the nails appear to grow.
  
- **Eponychium**
  - “*eponychium*” is Latin for “*on top of the little claw*”.
  - also called the “**cuticle**”.
  - where the skin merges with the top of the nail plate.
  
- **Hyponychium**
  - “*hyponychium*” is Latin for “*under the little claw*”.
  - also called the “**quickness**”.
  - where the skin merges with the bottom of the nail plate.
  
- **Nail Root**
  - most of it is not visible.
  - is where the nail grows outward.
  - wrapped by the Nail Matrix cells
  
- **Lunula**
  - “*lunula*” is Latin for “*Little Moon*”.
  - the visible part of the nail root.
  - most noticeable on the thumb (may not be visible on every digit).
  - lunula is not actually white, but appears that way when viewed through the nail (*blood vessels are obscured here*).
  - damaging the lunula will deform nail growth.
  
- **Nail Matrix**
  - cells of the Nail Matrix wrap around the proximal end of the nail root.
  
- **Nail Bed**
  - the nail plate is attached to the nail bed.

