Lab Exercise # 4
Integumentary System

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Anatomy and Physiology I

03/04/2013

What are the major characteristics of the skin?

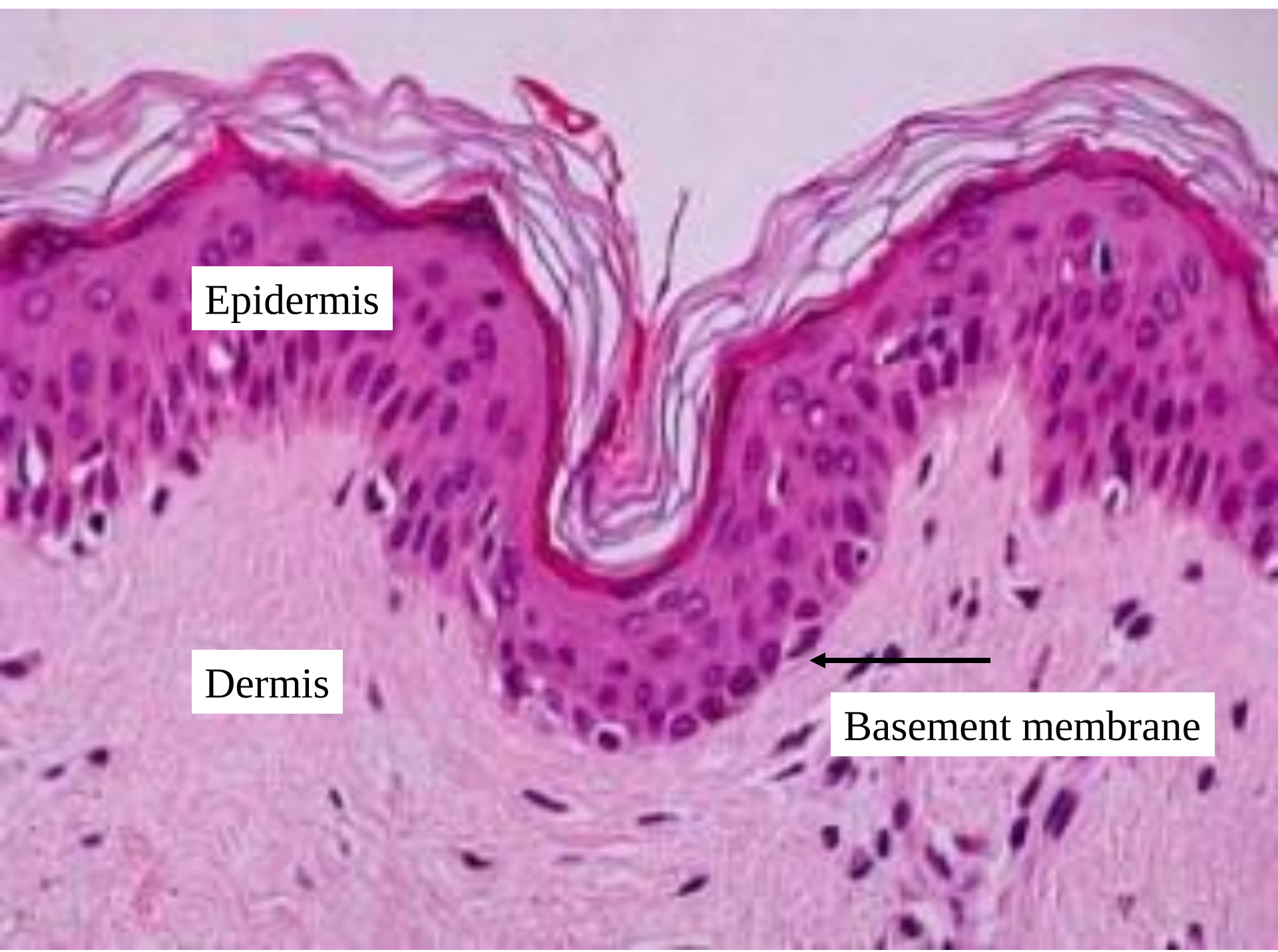
- Waterproof, stretchable, washable, and repairable
- One of the largest organ systems of the body
- Functions:
  - Regulation of temperature
  - Osmoregulation
  - Excretion
- Protection:
  - infections
  - UV damage
  - abrasions
- Synthesis of Vitamin D

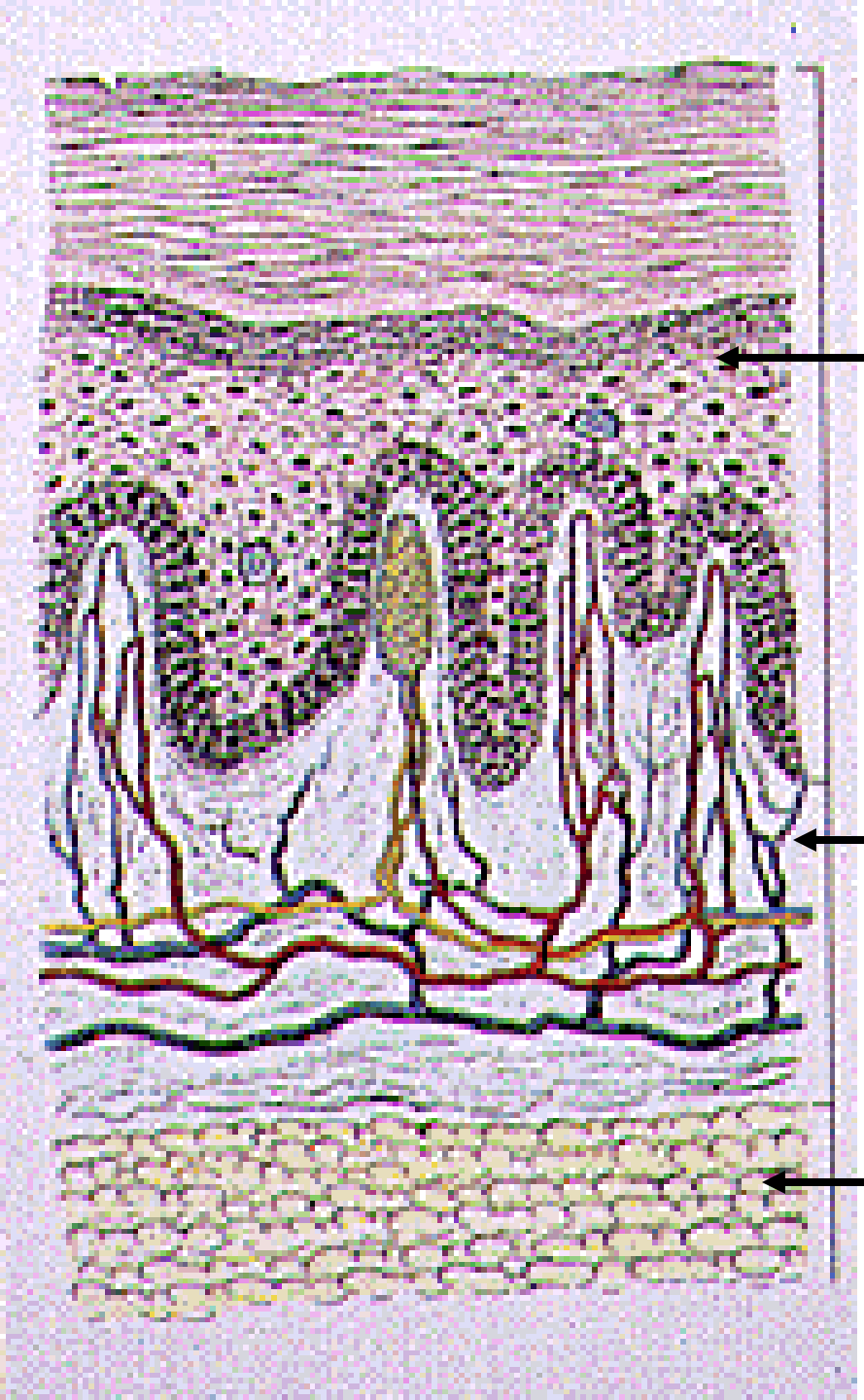
2 Skin Layers

- Epidermis (*epi*-upon)
  - Most superficial layers
  - Consists of 4-5 layers (from superficial to deep)
    - Stratum corneum
    - Stratum lucidum (only found in thick skin)
    - Stratum granulosum
    - Stratum spinosum
    - Stratam basale
      - Composed of keratinocytes, melanocytes (pigment cells) and Merkel cells (tactile cells)
      - Melanocytes produce melanin and keratinocytes phagocytose (take up) melanin and take it to the more superficial layers
      - The keratinocytes accumulate keratin and then organelles die
      - These cells eventually form the stratum corneum and slough off from the surface
      - In some places, the epidermis penetrates the deeper dermis and froms glands such as sudoriferous (sweat) and sebaceous (oil) glands. It also contributes to some hair follicles
  - Composed of epithelial tissue (stratified squamous)
  - Non-vascularized

2 Skin Layers

- Dermis – underlies the epidermis
  - Consists of 2 layers
    - Papillary-superficial
    - Reticular-deep
  - Tough leathery layer composed of fibrous connective tissue
  - Good supply of blood and rich nerve layer
  - Dermis pushes into the epidermis to form dermal papillae (fingerprints)
  - Accessory structures associated with the dermis layer
    - Sudiferous glands (sweat), sebaceous (oil) glands, hair follicles, fat cells, sensory receptors, and smooth muscle.


Epidermis
Dermis
Basement membrane

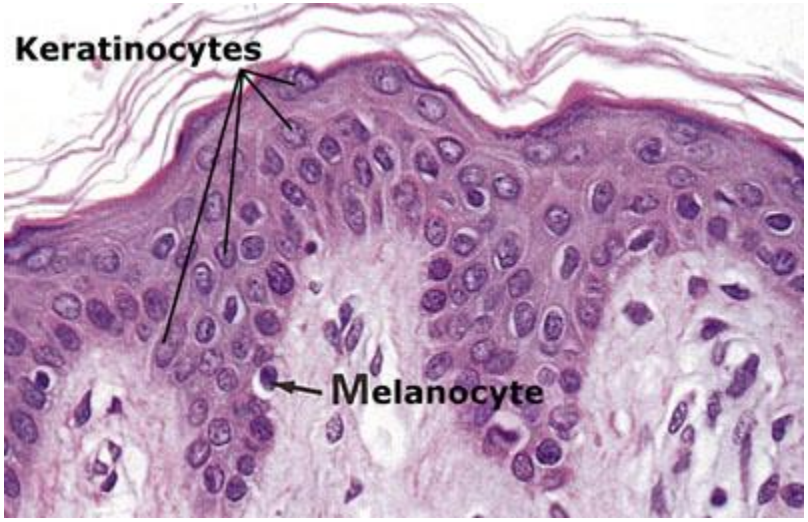

Epidermis
Dermis
Hypodermis

Subcutaneous Layer (below the skin)

- Hypodermis (not considered skin)
  - Connective Tissue layer
  - Made of adipose and areolar tissue
  - Highly vascularized
  - Stores fat and anchors skin

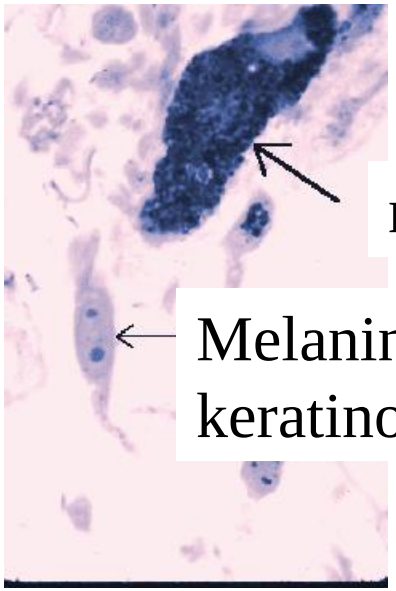
What are the different types of cells in the epidermis?

- Keratinocytes
  - Produce a fibrous protein called keratin
  - Are formed in the lowest levels of the epidermis.
  - Pushed upward by the production of new cells beneath them.
  - Become dead and scale-like
  - Millions rub off everyday



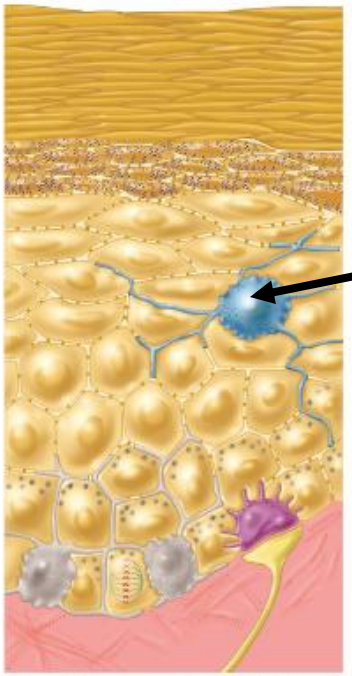
What are the different types of cells in the epidermis?

- Melanocytes
  - Synthesizes the pigment melanin
  - *Melan*-black
  - Can transfer melanin to keratinocytes
  - Protects skin from ultraviolet light.



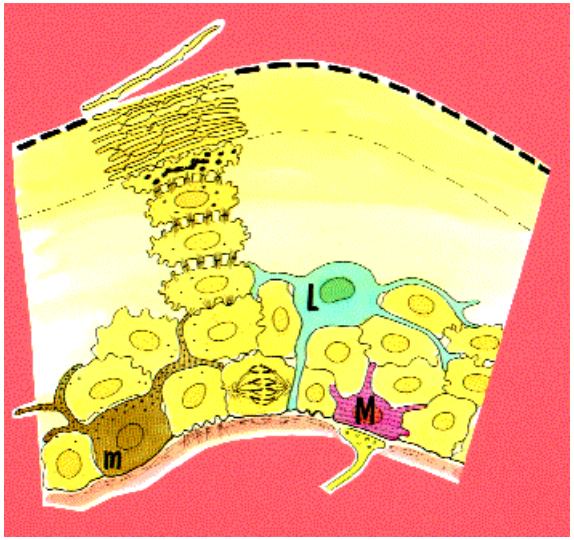
What are the different types of cells in the epidermis?

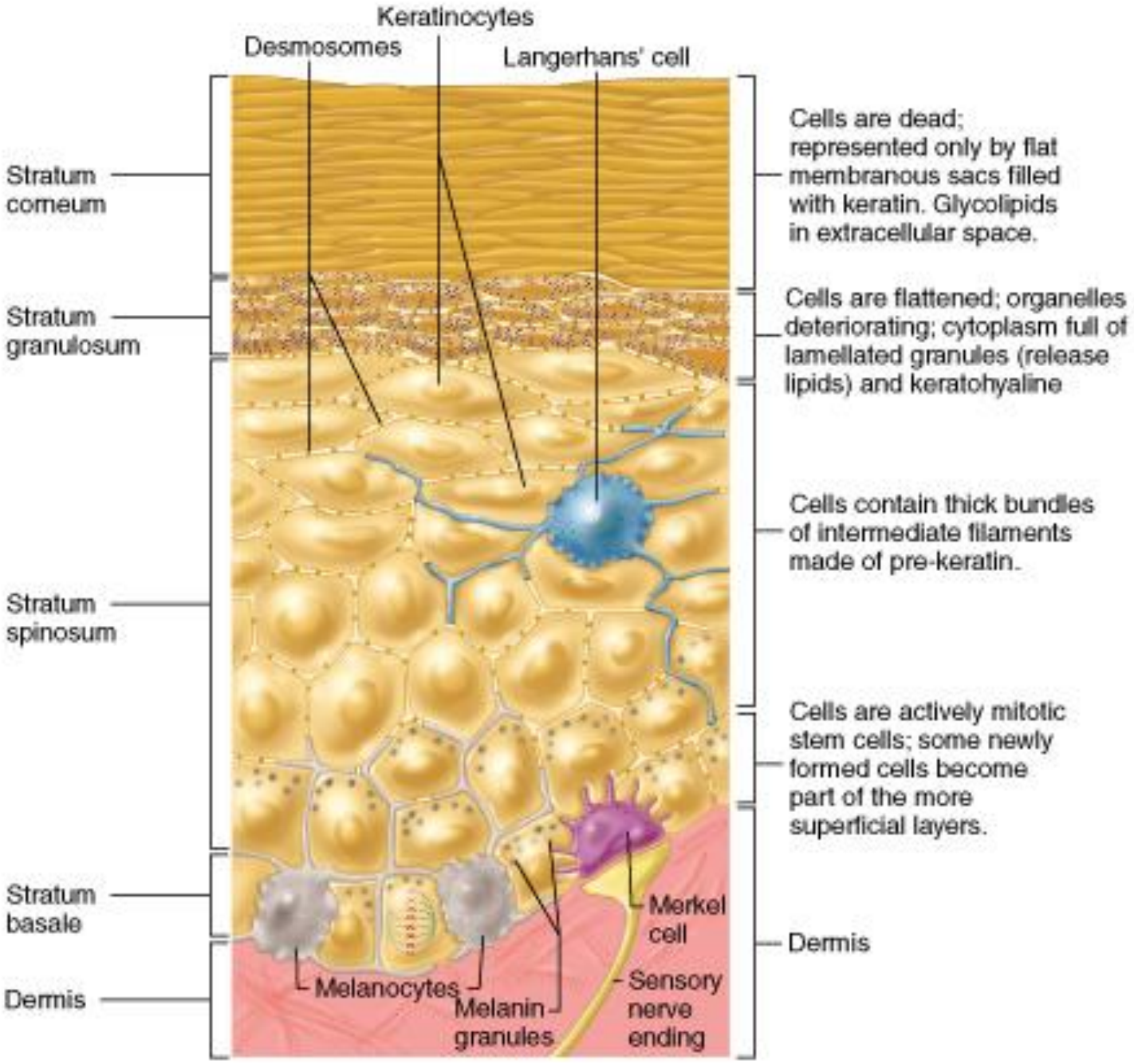
- Langerhans' cells
  - Formed in bone marrow.
  - Move to the skin
  - Macrophages

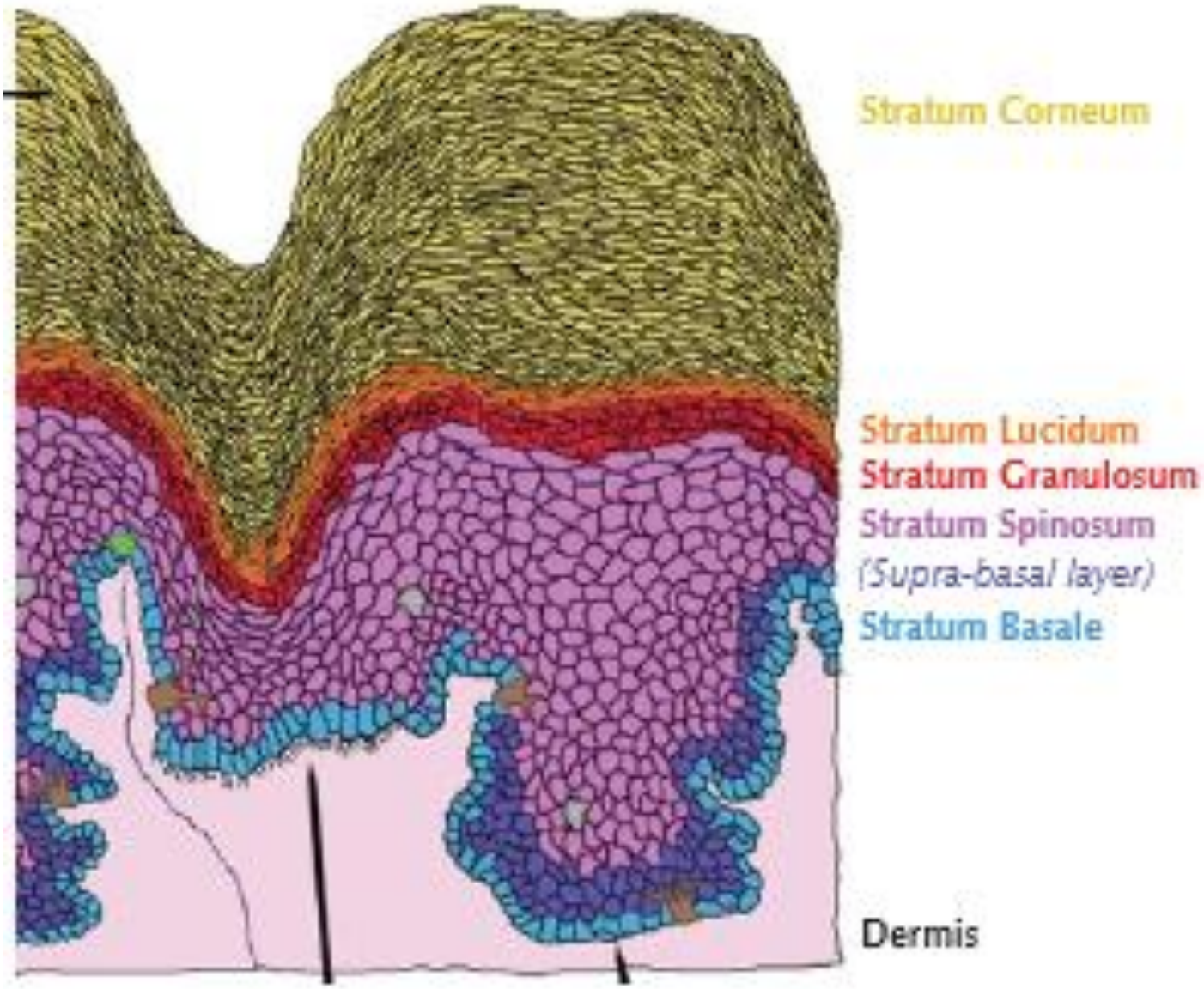


What are the different types of cells in the epidermis?

- Merkel Cells
  - Has a spiked appearance
  - Connected to nerve cells from dermis
  - Function as sensory receptors for touch.




Keratinocytes
Desmosomes
Langerhans' cell
Stratum corneum
Stratum granulosum
Stratum spinosum
Stratum basale
Dermis
Cells are dead; represented only by flat membranous sacs filled with keratin. Glycolipids in extracellular space.
Cells are flattened; organelles deteriorating; cytoplasm full of lamellated granules (release lipids) and keratohyaline
Cells contain thick bundles of intermediate filaments made of pre-keratin.
Cells are actively mitotic stem cells; some newly formed cells become part of the more superficial layers.
Dermis
Merkel cell
Melanocytes
Melanin granules
Sensory nerve ending


Stratum Corneum
Stratum Lucidum
Stratum Granulosum
Stratum Spinosum
(Supra-basal layer)
Stratum Basale
Dermis

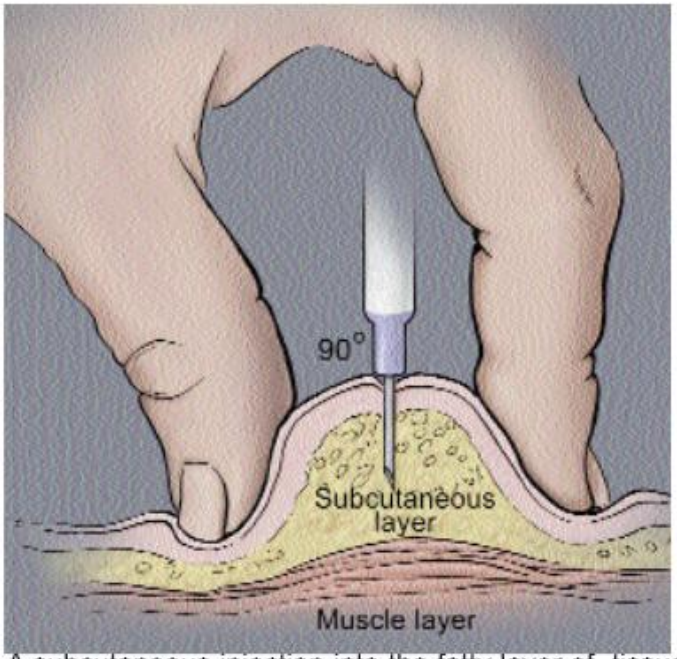
What are the characteristics of the dermis?

- Made up of connective tissue
- Richly supplied with blood vessels and lymph vessels
- Has hair follicles, oil and sweat glands and sensory receptors
- Ridges formed from the papillary layer can form finger prints.

Thin versus Thick Skin

- Most of the body is covered in thin skin while certain areas such as the anterior surface of the hands and soles of the feet are covered by thick skin.
- In thick skin, the epidermis has stratum lucidum and a thicker stratum corneum. The dermis and underlying hypodermis are also thickened.
- Thick skin also has a greater density of sudoriferous glands, but lacks sebaceous and hair follicles.

Hypodermis Layer



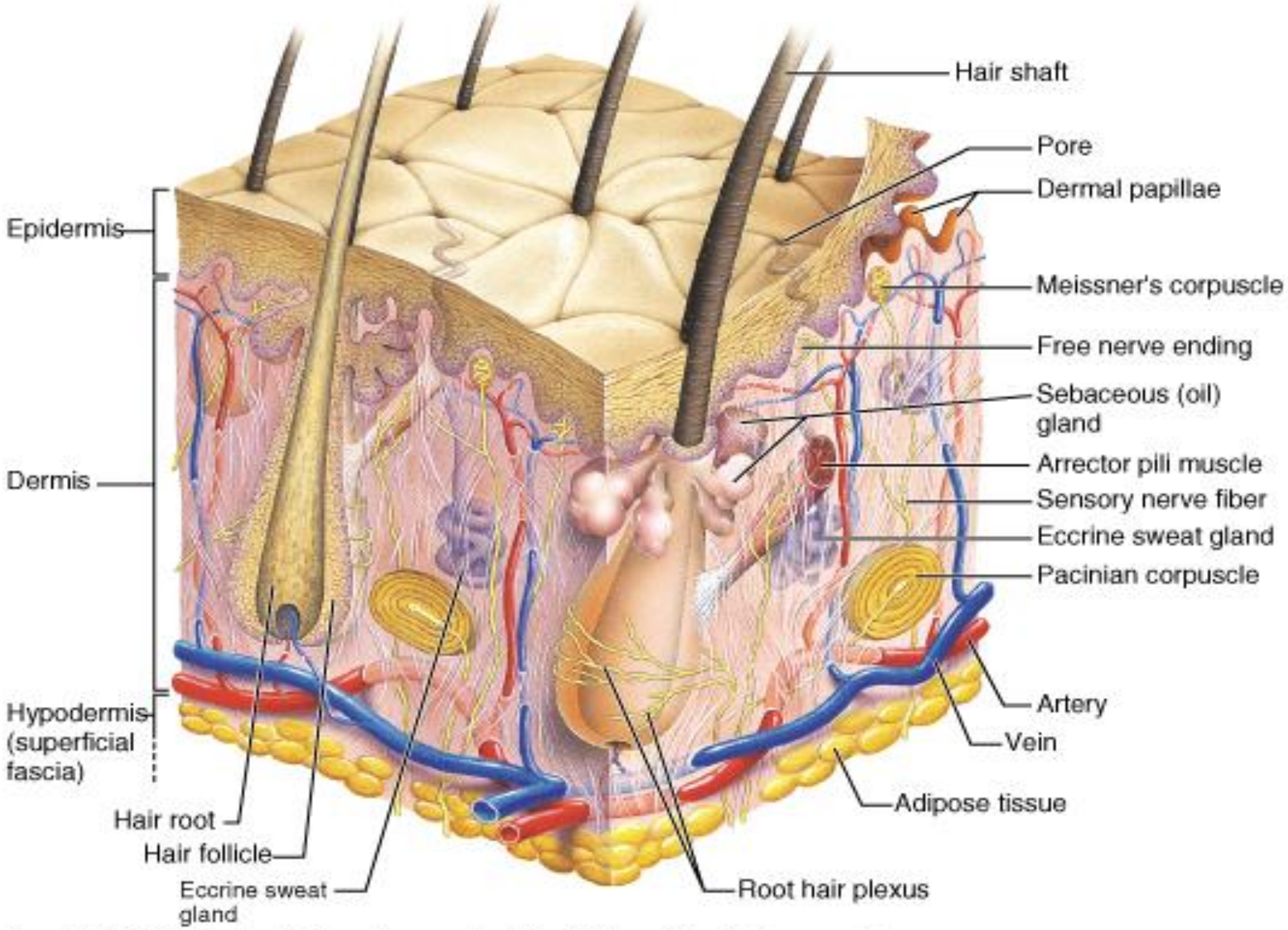
A subcutaneous injection into the fatty layer of tissue (pinched up to give the injection) under the skin.

Why are subcutaneous injections given?

These injections are given because there is little blood flow to fatty tissue, and the injected medication is generally absorbed more slowly, sometimes over 24 hours. Some medications that can be injected subcutaneously are growth hormone, insulin, epinephrine, and other substances.

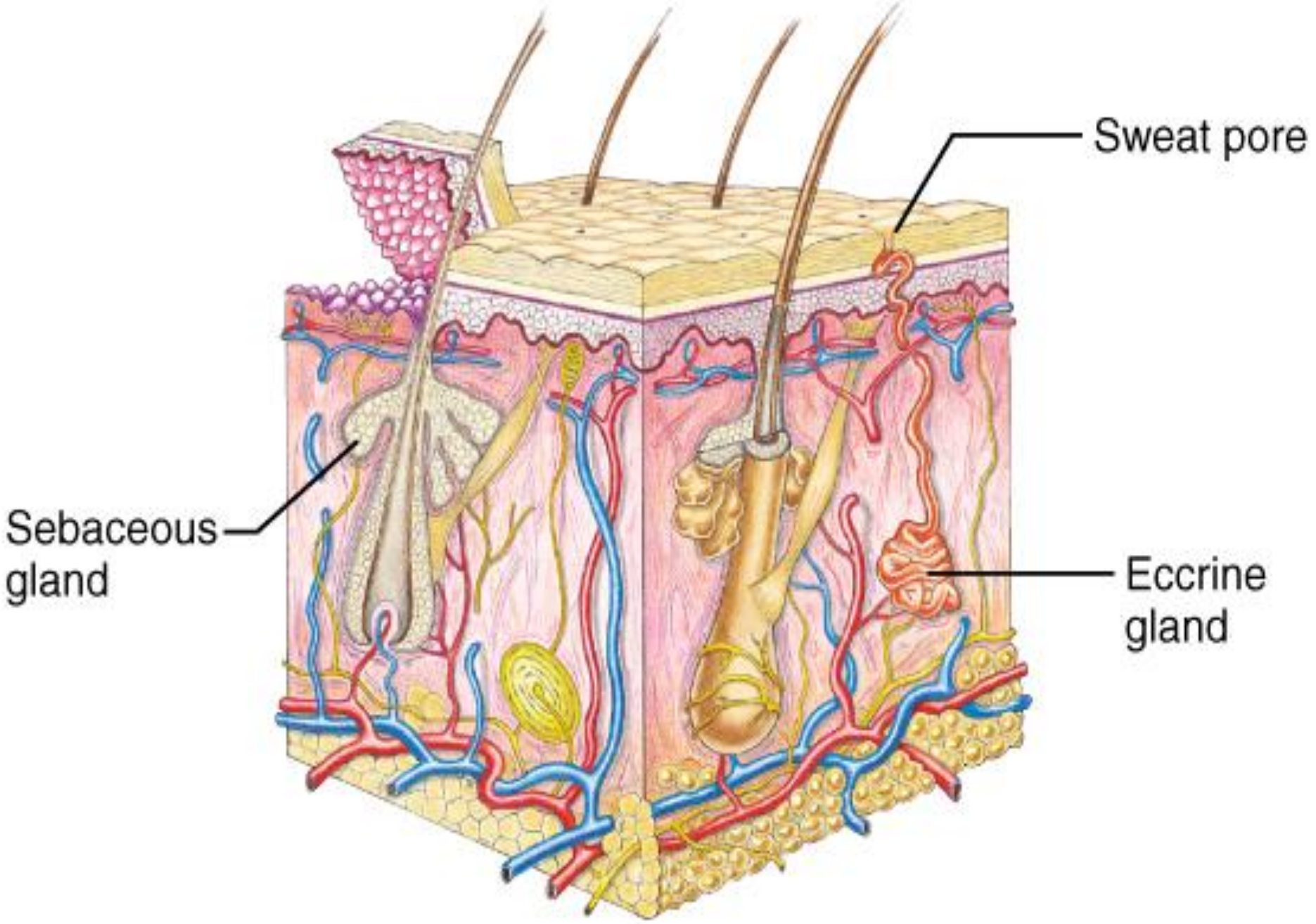
What are the major appendages of the skin?

- Sweat glands
- Sebaceous glands
- Hairs
- Nails



What are the types of glands found in the skin?

- Sweat glands-sudoriferous
  - **Merocrine**- common sweat glands
    - Located everywhere palms, soles, forehead
    - Controlled by the Sympathetic Division of the Autonomic Nervous System
    - Heat-induced sweat—begins on forehead and branches out
    - Cold sweat—begins on palms, soles and armpits
  - **Apocrine**- produce sweat plus a milky or yellowish substance composed of fat and protein.
    - Found in the arm pits and genitalia
    - Become functional at puberty
    - Odorless …
      - Until bacteria break it down→BODY ODOR
  - **Ceruminous**- produce cerumen (ear wax)
  - **Mammary glands**- produce milk
- Sebaceous glands- oil glands (sebum)
  - Softens and lubricates hair and skin
  - Slows water loss and kills bacteria



Sensation

- The skin has receptors that help us detect changes in our environment
- **Phasic receptors** (detect odor and temperature) respond strongly at the onset of the stimulus, but then adaptation causes the sensation to fade gradually or even to stop
- **Tonic receptors** (pain receptors) adapt slowly and the sensation continues the entire time the stimulus is present.

Sensory Neurons

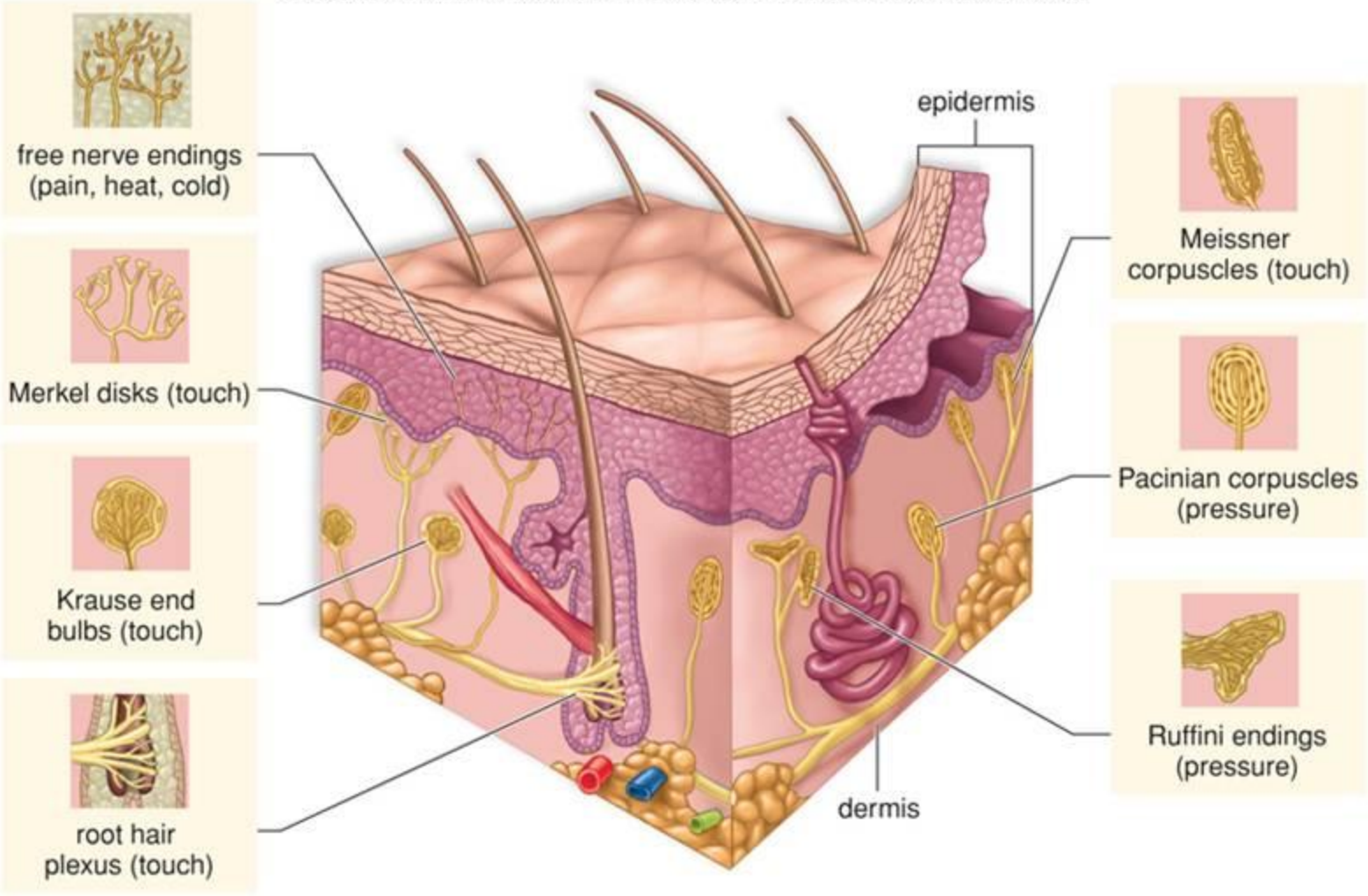
- Some of the receptors are called sensory neurons. The branches of the neurons spread and receive stimuli from a particular area of the skin called the receptive field
- Depending upon how much the area of the skin is supplied by the branches of the a single sensory neuron, receptive fields can be large or small.
- A stimulus must occur within the receptive field in order to be detected.
  - Some parts of the body are crowded with light touch receptor fields that are very close together while other parts have them so far apart that the regions of the skin are left without the ability to detect light touch.

Sensory Receptors in the skin

- **Cutaneous mechanoreceptors**
  - Free nerve endings (detect touch, pressure and stretching)
  - Hair follicle receptors (sense position changes of hairs)

Cutaneous Sensory Receptors

Receptor Type	Location	Function	Rate of Adaptation
Free Nerve Endings	-glabrous and hairy	Temperature, Pain, Crude Touch	Slow
Meissner's Corpuscles (stack of flattened disks)	-glabrous skin -in the dermis right below the epidermis	Touch, Pressure (dynamic)	Rapid
Pacinian Corpuscles (onion like)	-glabrous and hairy -Subcutaneous tissue -found deep within the skin	Deep pressure, Vibration (static)	Rapid
Merkel's Disks (Disc shaped)	-glabrous and hairy -found near border between epidermis and dermis	Touch, Pressure (static)	Slow
Ruffini's Corpuscles (branched fibers)	-Hairy	Stretching of skin	Slow
Hair follicle receptors	Hair follicles	Sense position changes in hair	Rapid

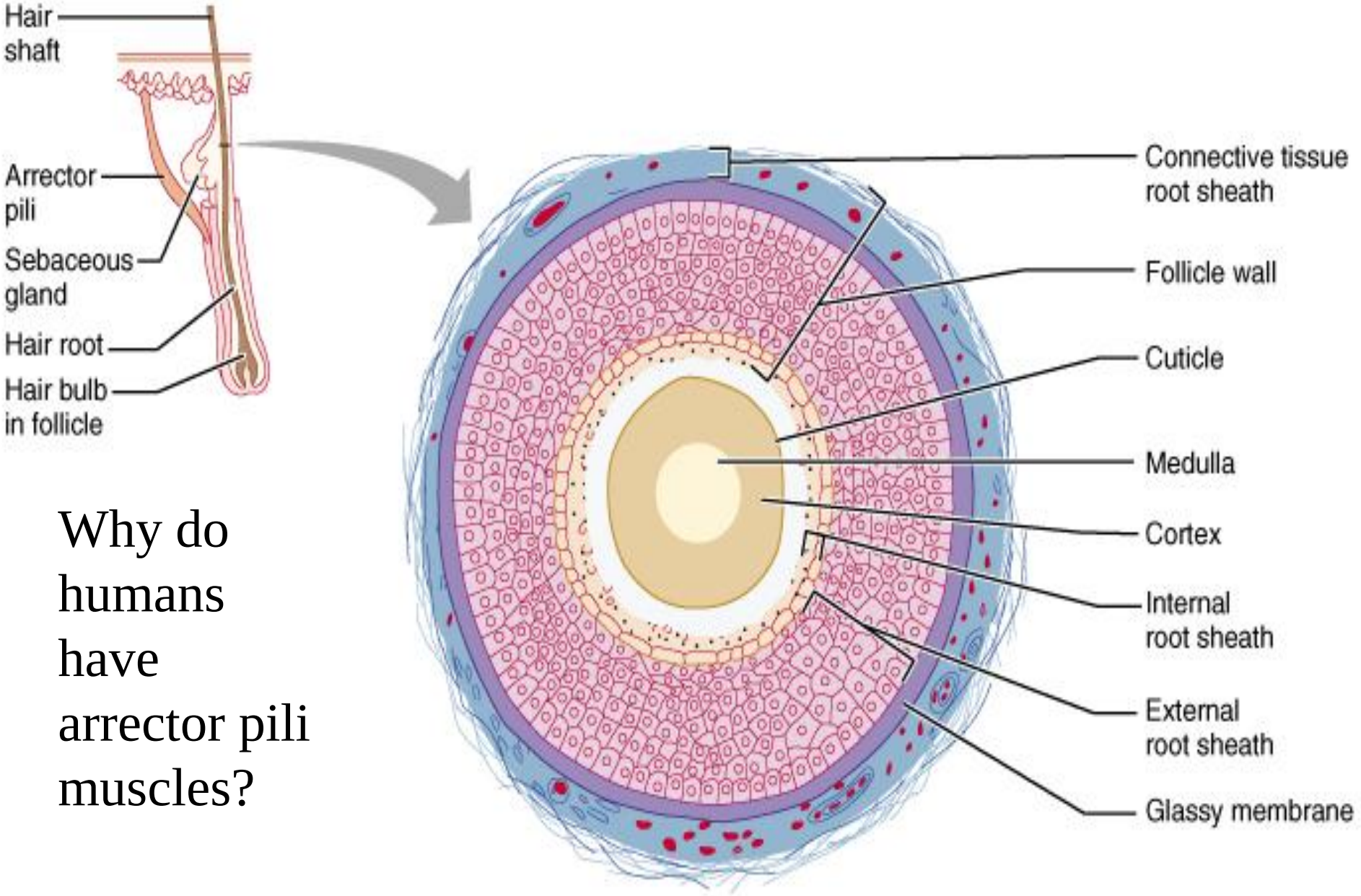


Why is hair useful?

- Senses insects that land on the skin.
- Hair on the head protects the head from a blow, sunlight and heat loss.
- Eyelashes shield the eye
- Nose hairs filter the air

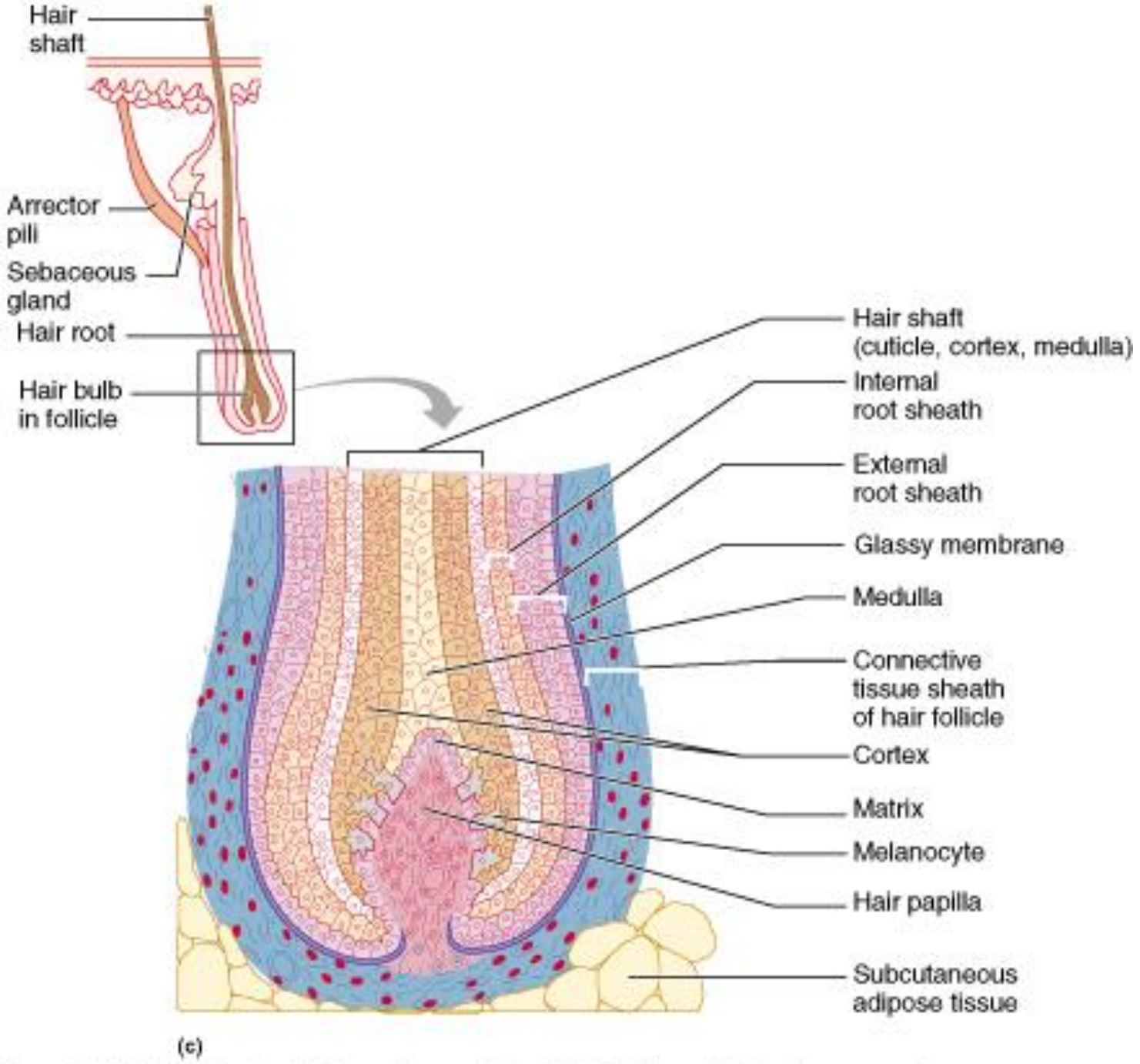
What are hairs?

- Made from hair follicles
- Made of dead keratinized skin cells
- Two parts shaft and root
- Shaft has 3 layers of cells
  - Medulla(central core)
  - Cortex (bulky layer)
  - Cuticle (heavily keratinized; protects hair)



Why do humans have arrector pili muscles?

(a)



(c)

What are the primary functions of the Integumentary System?

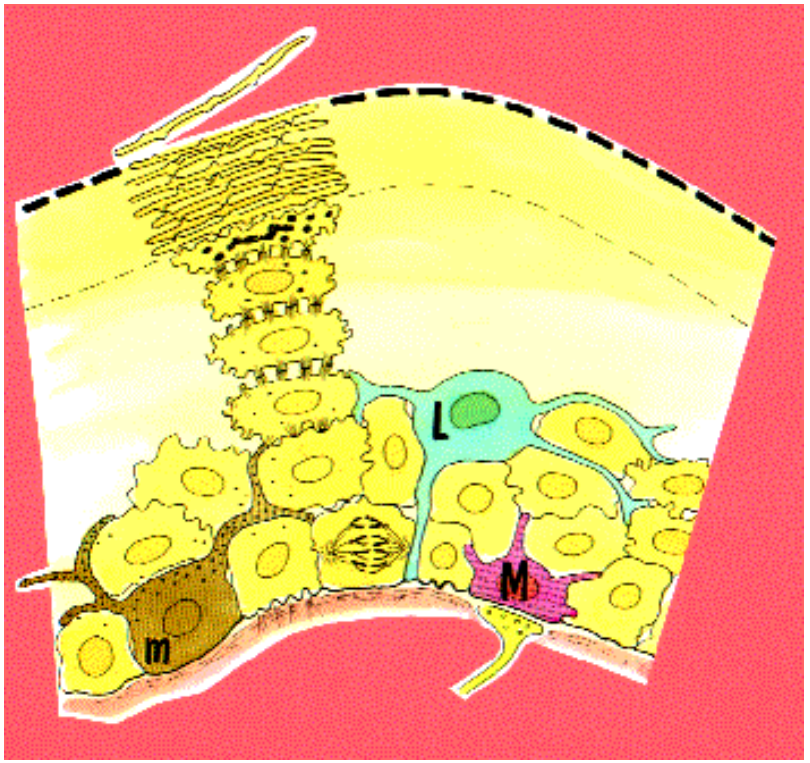
- Protection: provides 3 types of barriers
  - Chemical barriers: low pH of skin secretions slows bacterial growth. Human defensin is an antibiotic that destroys bacteria (produced by human skin)

Physical barriers

- Physical barriers: very few substance are able to enter the skin. Substances able to pass.
  - Lipid-soluble substances: oxygen, carbon dioxide, some vitamins
  - Oleoresins- poisons (poison ivy)
  - Organic solvents- dry-cleaning fluid, paint thinner
  - Salts of heavy metals- lead, mercury, nickel
  - Penetration enhancers- drug agents that help substances into the body.

Biological barriers

- Langerhans' cells- act as macrophages police the epidermis for viruses and bacteria.



Functions cont.

- **Thermoregulation**- skin contains sweat glands that secrete watery fluid, that when evaporated, cools the body.
- **Sensation**- Skin contains sensory receptors that detect cold, touch, and pain.
- **Vitamin D synthesis**- cholesterol in the skin is bombarded by sunlight and converted to vitamin D (calcium cannot be absorbed from digestive tract)

Functions cont.

- **Blood reservoir**- blood will be moved from skin to muscles during strenuous activity.
- **Excretion**- Sweating is an important outlet for wastes such as salt and nitrogen containing compounds. (urine)

Lab Exercise # 4
Integumentary System

Dr. McGehee

Anatomy and Physiology I

03/04/2013

Reminder!

- Sit with your lab members
- Work with your lab members closely
  - 1. Make sure the whole group knows the subject (you depend on the whole group for future quizzes and extra credit points)
    - Quiz each other
    - Discuss questions and answers out loud
    - Teach other lab members. Teaching helps retain knowledge!
  - 2. Have each person look at a different slide and rotate through to speed up the process
  - 3. You must complete your own lab report and turn it in! No lab work is accepted.
  - 4. The lab report must be completed in order to get credit! Do not leave anything blank.

Procedure (pg. 44-46)

- A1. Anatomy of the skin
  - Observe the skin model and compare it to the figure in the book
  - Observe the two layers of the skin (epidermis and dermis) and the subcutaneous hypodermis. Use the checklist to identify the structures in the lab book

Procedure

- A2. Skin Slides
  - Obtain the scalp and pigments skin slides
  - Scan the different layers of skin using the compound microscope using the 10X and the 40X
  - Answer Part A questions 1-10 on page 49-52

Procedure

- B. Accessory structures of the skin
  - Observe your finger print and crease lines under the microscope
  - Compare skin that has hair with hairless skin
  - Compare curly, wavy, straight, and “split” hair
  - Attempt to pull out a single hair with its root and follicle attached
    - Mount it on a microscope slide and put a coverslip over it
    - Observe the hair root, shaft, and follicle under a microscope (4x) objective
  - Answer Part B questions 1-6 on page 52-53

Procedure

- C. Testing for density of sudoriferous glands
  - This experiment is based on the fact that paper is made up of a polysaccharide called cellulose and when iodine in Betadine comes in contact with cellulose it turns from a yellow-brown to a blue-black color. Where ever the pores of the sudorifours glands open on the skin, the sweat will bring iodine in contact with the paper and produce a blue spot. The density of the dark spots on the paper represents the density of the sudorifours glands.

Procedure

- C. Testing for density of sudoriferous glands
  - Obtain 4 squares of 1X1 cm of bond paper
  - Identify the antero-medial surface of the palm and posterior surface of the hand to compare think and thick skin. Make sure these selected areas are wiped dry with a paper towel and that the areas do not have major crease lines.
  - With a cottom swab, apply a very thin coat of Betadine to each of the two areas. Allow dye to dry before next step
  - Place a paper square on each area and secure it with surgical tape.
  - Leave in place for 2-10 min
  - Remove the tape and observe under the microscope
  - Each blue-black dot represents a secretion of an active sudoriferous gland. Observe the density
  - Record you observations and answer the Part C questions on page 53
    - Hint : antero-medial= located in front and toward the middle
    - Hint: hirsute=covered with coarse stiff hairs

Procedure

- D. Sensory Testing
  - Have your lab partner sit with eyes closed and thier arms resting on the lab table
  - Using the aesthesiometer, with its points as close together as possible, gently press the two points simultaneously against the skin of the forearm.
  - Ask the subject to report whether the 2 tips are perceived as 1 or 2 points
  - Measure the distance between the 2 points and record in section D of the lab report.
  - Increase the distance between the two points and repeat the question
  - Continue until the 2 tips are perceived as 2 points. This indicates the size of the receptive field for that area of the body.
  - Record results and repeat steps for the following areas of the skin: back of the neck, the palm of the hand, and the upper arm.
  - Record answers on page 54 and complete the critical thinking questions on page 55.