

Chapter 5 Integumentary System

Functions of the Integumentary System (I.S.)

Petite	Protection
Rhinos	Regulation of Body Temperature
Can't	Cutaneous Sensation
Mimic	Metabolic Function
Big	Blood Reservoir
Elephants	Excretion

Protection

The I.S. provides the body with a **CHEMICAL BARRIER** via secretions that lower pH which retards bacterial growth. The skin also secretes *human defensin*, a natural antibiotic. The I.S. also acts as a **PHYSICAL BARRIER**. The keratinized surface is tough and water resistant. Plus, it's dead...so it's hard to harm something that isn't living. The I.S. also acts as a **BIOLOGICAL BARRIER**. Langerhans cells & macrophages reside in the skin.

Regulation of Body Temperature

When it is hot out, the body utilizes **VASODILATION** to bring blood closer to the surface to help dispel the heat. When it is cold, the body utilizes **VASOCONSTRICTION** to pull the blood away from the surface. Also, **SWEAT GLANDS** carry heat away from the body via evaporation.

Cutaneous Sensation

The I.S. has receptors for temperature, light touch, pressure and pain.

Metabolic Function

The I.S. activates Vitamin D and supplements chemical conversions relating to the liver.

Blood Reservoir

About 5% of the body's blood volume is held in the skin. When the body undergoes severe blood loss, this reservoir is diverted from the skin to the internal organs where it is needed most.

Excretion

The I.S. excretes small quantities of nitrogenous wastes, as well as a few other wastes.

Anatomy of the Skin

The skin is cutaneous membrane. All membranes are made up of two types of tissues...an epithelial component and a connective tissue component. The epithelial layer is the epidermis. The connective tissue layer is the dermis.

Characteristics of the Epidermis

The epidermis is the epithelial component of the cutaneous membrane (skin). It is characterized by:

- Stratified squamous cells
- Keratinized cells (a feature unique to skin cells)
- Avascular (remember... minor paper cuts do not bleed!)

Cells of the epithelium are:

- **Keratinized stratified squamous** (the predominant cell). These cells produce fibrous protein called keratin. They are shed every 25-45 days.
- **Melanocytes**. They are located in the deepest layer and are highly branched cells whose extensions inject melanin into keratinocytes. The pigment melanin is produced in melanosomes. Melanin absorbs UV radiation.
- **Langerhans cells**. (aka epidermal dendritic cells). These cells are part of the immune system. They don't attack, but rather act as scouts and alert the immune system that help is needed. They arise in bone marrow and migrate to the skin. They have many cellular extensions that help them to detect invading cells.
- **Merkel cells**. These are located in the deepest layer of the epidermis because they remain in contact with a free nerve ending. They act as light touch receptors.

The 5 layers of epidermis!

Stratum basale

- Regenerates sloughed cells
- Location of skin stem cells
- 1-layer thick

Stratum spinosum (spiny layer)

- Contains Langerhans cells
- Keratinocytes contain melanosomes
- Melanin is here!

Stratum granulosum

- Keratin production begins
 - Stored in packets
 - Provides strength and water resistance
- Cells begin to flatten & die

Stratum lucidum

- Only present in thick skin*
- Thin, clear layer of flattened cells
- This is not what makes thick skin thick

Stratum corneum

- Thick layer of dead cells
- Cells are cornified...horn-y...hard and tough
- This layer is thicker in thick skin

5 layers of epidermis	
Boys	Basale
Suck	Spinosum
Girls	Granulosum
Love*	Lucidum*
Cats	Corneum

Layers of the dermis

Papillary layer

- Thin layer of areolar CT
- Dermal papillae are present. These are irregular pegs of CT that protrude up into the dermis like an egg-crate mattress
- This forms extensive ridges in thick skin (fingerprints!)

Reticular layer

- Thicker dense irregular CT
- Highly vascular & innervated
- Houses epidermal appendages (hair, nails, glands)

Skin Color

HEMOGLOBIN is a red pigmented molecule. It carries oxygen in the blood. Skin is semi-translucent, so red capillaries show through, giving a pinkish color to lighter-skinned people.

CAROTENOIDS are brownish-yellow/orange-ish pigment molecules. The breakdown products of some nutrients get deposited in skin (carrots!)

MELANIN is the major source of skin color. It is produced by melanocytes as a response to exposure of the skin to UV radiation. Melanin absorbs UV rays to protect the chromosome from mutation. There are three varieties of melanin:

- 1) reddish brown (Native American)
- 2) yellow-ish brown (Asian)
- 3) blackish brown (African, Mediterranean)

RACIAL DIFFERENCES in skin color are not because of the number of melanocytes. The number of melanocytes among different races is roughly equal. The differences result in varying amounts of different hues of melanin. The darkness of one's skin has to do with the size and persistence of the melanosomes and where it is in the epidermis (how close to the superficial layer).

Epidermal Appendages (sweat glands, nails, hair)

SUDORIFEROUS GLANDS are the sweat glands. There are two types.

1. Eccrine sweat glands
 - a. These are everywhere!
 - b. They produce a watery sweat to help cool the body via evaporative cooling
 - c. SOME on while SOME off
 - d. Secretes by merocrine method

2. Apocrine sweat glands
 - a. Develop at puberty
 - b. Located in axilla, inguinal region, around nipples
 - c. Produce milky sweat that is high in lipids and proteins
 - d. Function is unclear, probably pheromonal
 - e. ALL on or ALL off
 - f. Secretes by merocrine method.

SEBACEOUS GLANDS

- secrete the oily sebum onto the surface of the skin and onto the hair shaft.
- Located only in thin skin
- Purpose is to lubricate skin & hair, prevent water loss and contains antibiotics

CERUMENOUS GLANDS

- Located in external ear canal
- Secretes cerumen (ear wax)
- Purpose is to capture particulate matter in the ear canal

MAMMARY GLAND

- Modified apocrine sweat gland
- Secretes milk

NAILS

- Protect the distal dorsal surface of digits
- Made up of modified epidermis, where the epithelial cells produce HARD KERATIN
- Grows from an area called the NAIL MATRIX
 - Heavily keratinized cells are pushed out over the nail bed
 - Seen on nail as white crescent called LUNULA
- Cuticle is also known as the EPONYCHIUM

HAIR

- Provides limited protection
- Covers all of the skin except for the palms, soles, lips, nipples and parts of the external genitalia
- It is a column of dead keratinized cells in concentric layers
- Produced of HARD KERATIN
- Grows in the HAIR FOLLICLE from the HAIR MATRIX
- HAIR MATRIX is a single layer of epidermal cells that overlies the HAIR PAPPILLAE (a peg of dermal tissue at base of the follicle)
- Hair grows at a rate of about 0.33 mm per day.
- Rate varies by body region, gender and age

Hair growth cycle

Each follicle is active for weeks to years...the scalp is active for 6-10 years while the eyebrows are 3-4 months. This explains why your eyebrows never get as long as your hair. At the end of its active period, the hair follicle is inactive for a period of a few weeks or months. At this time the hair may fall out when the hair matrix cells die. As the matrix cells proliferate, new hair forms. As the new hair forms it will push old hair out of the follicle if any is present.

The ARRECTOR PILI MUSCLE pulls hair follicle upright in response to cold or fear. This is what gives us goosebumps!

Burns

Burns are caused by heat, electricity, chemicals and radiation (sunlight). The effects of burns on the microscopic level are denatured proteins and cell death. The effects on the clinical level are a loss of body fluids, metabolic imbalance and microbial infection.

RATING OF BURNS

- | | |
|------------------------|--|
| 1 st degree | -epidermis damaged
-regenerates in 2-3 days
-ex: sunburn |
| 2 nd degree | -epidermis & upper dermis damaged
-results in blistering
-heals in 2-3 weeks
-ex: scalding |
| 3 rd degree | -full thickness burn (epidermis & dermis)
-usually requires skin grafting, though technically CAN heal on its own. It would just take too long and the other factors are too dangerous. |

RULE OF NINES is used to estimate how much surface area has been lost so fluid replacement needs can be determined. The body is divided into 11 regions. Each region represents 9 percent, so take the number of regions and multiply by 9 to get the percentage.

1. Head & neck
2. Right arm
3. Left arm
4. Chest
5. Abdomen
6. Upper back
7. Lower Back & Buttocks
8. Right thigh
9. Left thigh
10. Right lower leg
11. Left lower leg

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