The Integumentary System

Objectives
• Describe the main structural features of the skin.
• Explain the mechanisms that produce hair and nails.
• Describe how skin responds to injury.

The integumentary system or integument is the largest system of the body.
- 16% of body weight
- 1.5 to 2 square meters in area

The integument is made up of 2 parts:
1. the cutaneous membrane, or skin,
2. the accessory structures

The cutaneous membrane is made up of 2 parts:
1. the outer epidermis or superficial epithelium (epithelial tissues) and
2. the inner dermis, composed of connective tissues

The accessory structures include hair, nails, and multicellular exocrine glands. These structures generally originate in the dermis and extend through the epidermis to the skin’s surface

Below the dermis is a subcutaneous layer of loose connective tissue, also known as the superficial fascia or hypodermis (where hypodermic injections are administered). This is not officially a component of the integument

The functions of skin and its subcutaneous layer include:
1. Protection against, abrasion, fluid loss and infection
2. Excretion of salts, water, and organic wastes by glands
3. Maintenance of body temperature by insulation (heating) and sweat evaporation (cooling)
4. Synthesis of vitamin
5. Storage of lipids
6. Detection of touch, pressure, pain and temperature

The Epidermis
The most abundant cells in the epidermis are the keratinocytes (so called because they contain large amounts of the protein keratin).

Most of the body is covered by thin skin, which has only 4 layers of keratinocytes in the epidermis.

The palms of the hands and soles of the feet are covered with thick skin, which has 5 layers of keratinocytes in its epidermis.
Skin color depends on:
   1. pigment - carotene and melanin.
   2. circulation

Carotene, an orange-yellow pigment found in carrots and other orange vegetables, accumulates in epidermal cells and in fatty tissues of the dermis. Carotene can be converted to vitamin A.

Melanin, a yellow-brown or black pigment, is produced by melanocytes
   - Skin color depends on the rate of melanin production, not the number of melanocytes.
   - Melanin protects the skin from the damaging effects of ultraviolet radiation (DNA mutations and burns, which lead to cancer and wrinkles).

Capillaries in the skin, carrying oxygenated red blood, contribute to skin color.
   - When blood vessels dilate from heat, skin turns red.
   - When blood flow decreases, skin pales.
   - Severe reduction in blood flow or oxygenation can give skin a bluish tint called cyanosis.

Several diseases can produce changes in skin color:
   - Jaundice, a yellow color resulting from buildup of bile from the liver.
   - Diseases of the pituitary gland that cause skin darkening.
   - Vitiglio, a loss of color (melanocytes).

The Dermis
The dermis, located between the epidermis and the subcutaneous layer, has 2 components, the outer papillary layer and the deeper reticular layer.

The papillary layer:
   - consists of areolar tissue
   - contains smaller capillaries, lymphatics and sensory neurons
   - has dermal papillae projecting between epidermal ridges

The reticular layer:
   - consists of dense irregular connective tissue
   - contains larger blood vessels, lymph vessels and nerve fibers
   - contains collagen and elastic fibers
   - contains connective tissue proper

The Subcutaneous Layer
Below the integument, the subcutaneous layer or hypodermis stabilizes the position of the skin but allows separate movement. Not truly part of integument.

The subcutaneous layer is made of elastic areolar and adipose tissues, connected to the reticular layer of the integument by interwoven connective tissue fibers.
Because the subcutaneous layer has few capillaries and no vital organs, it is the site of subcutaneous injections using hypodermic needles.

Deposits of subcutaneous fat, which accumulate in different areas in men and women due to hormonal effects, are the subject of cosmetic liposuction procedures.

**Accessory Structures**
The integumentary accessory structures (hair, hair follicles, sebaceous and sweat glands, and nails) are derived from the epidermis during embryonic development.

**Hair and Hair Follicles**
The human body is covered with hair, except for the palms, soles, lips, and portions of external sex organs.

Hairs have many functions, they:
- protect and insulate
- guard openings such as the nose against particles and insects
- are sensitive to very light touch

Produced by hair follicles deep in the dermis.
- The base of each follicle is surrounded by sensory nerves called the root hair plexus
- Involuntary smooth muscles called arrector pili cause hairs to stand on end and produce “goose bumps.”
- The lower part of the hair, attached to the integument, is the hair root.
- The upper part of the hair, not attached to the integument, is the hair shaft.
- Each hair follicle has a sebaceous gland which lubricates the hair.
- As hair is produced, it is keratinized.

**Glands in the Skin**
The skin has 2 types of exocrine glands: sebaceous (oil) glands and sweat glands.

Sebaceous glands (oil glands) secrete sebum.
Sebum contains lipids and other ingredients that lubricate and protect the epidermis, and inhibit bacteria.

There are 2 types of sweat glands (sudoriferous glands): apocrine and merocrine.

Apocrine sweat glands are found in the armpits, around the nipples and groin

Merocrine (eccrine) sweat glands are widely distributed over the body surface, especially on the palms and soles. These are coiled, tubular glands that discharge directly onto the skin surface. Merocrine sweat is sensible perspiration, mostly water with some salts and other organic compounds.
Other integumentary glands include:
- mammary glands, which produce milk, and
- ceruminous glands, which protect the eardrum by producing cerumen or earwax.

Nails
- Nails are dead cells packed with keratin.
- Production occurs in a deep epidermal fold near the bone called the nail root.

The Response of the Integument to Injury

Repair of Localized Injuries to the Skin
Because skin has so many active germinative cells, it responds rapidly to changes in health, activity or injuries.

There are 4 steps in the regeneration of localized skin injuries.

Step 1: Bleeding occurs. Mast cells trigger an inflammatory response.
Step 2: Blood clots form a scab that stabilizes and protects the area. Germinative cells migrate around the wound. Macrophages clean the area. Fibroblasts move in and divide, along with endothelial cells of damaged blood vessels, producing granulation tissue.
Step 3: Over time, fibroblasts replace damaged tissues with a fibrous repair called scar tissue. Inflammation decreases and the clot begins to disintegrate.
Step 4: Fibroblasts continue to strengthen the area until a raised section of scar tissue called a keloid forms.

Burns
A method of estimating the percentage of integument damaged by burns is the “rule of nines,” which divides the surface area of the adult body into multiples of nine.