

## Integumentary System

The skin is the largest organ in the body: 12-15% of body weight, with a surface area of 1-2 meters. Skin is continuous with, but structurally distinct from **mucous membranes** that line the mouth, anus, urethra, and vagina. Two distinct layers occur in the skin: the dermis and epidermis. The basic cell type of the **epidermis** is the keratinocyte, which contain keratin, a fibrous protein. **Basal cells** are the innermost layer of the epidermis. **Melanocytes** produce the pigment melanin, and are also in the inner layer of the epidermis. The dermis is a connective tissue layer under the epidermis, and contains **nerve endings**, **sensory receptors**, capillaries, and elastic fibers.

The integumentary system has multiple roles in homeostasis, including protection, temperature regulation, sensory reception, biochemical synthesis, and absorption. All body systems work in an interconnected manner to maintain the internal conditions essential to the function of the body.

### Follicles and Glands

Hair follicles are lined with cells that synthesize the proteins that form hair. A **sebaceous gland** (that secretes the oily coating of the hair shaft), **capillary bed**, nerve ending, and small muscle are associated with each **hair follicle**. If the sebaceous glands becomes plugged and infected, it becomes a skin **blemish** (or **pimple**). The **sweat glands** open to the surface through the skin pores. **Eccrine glands** are a type of sweat gland linked to the sympathetic nervous system; they occur all over the body. **Apocrine glands** are the other type of sweat gland, and are larger and occur in the **armpits** and **groin** areas; these produce a solution that bacteria act upon to produce “body odor”.

### Hair and Nails

Hair, **scales**, feathers, **claws**, horns, and nails are animal structures derived from skin. The hair shaft extends above the skin surface, the hair root extends from the surface to the base or **hair bulb**. Genetics controls several features of hair: **baldness**, color, texture.

**Nails** consist of highly keratinized, modified epidermal cells. The nail arises from the nail bed, which is thickened to form a lunula (or little moon). Cells forming the **nail bed** are linked together to form the nail.

### Skin and Homeostasis

Skin functions in homeostasis include protection, regulation of body temperature, sensory reception, water balance, synthesis of vitamins and hormones, and absorption of materials. The skin’s primary functions are to serve as a barrier to the entry of microbes and viruses, and to prevent water and extracellular fluid loss. Acidic secretions from skin glands also retard the growth of **fungi**. Melanocytes form a second barrier: protection from the damaging effects of **ultraviolet radiation**. When a microbe penetrates the skin (or when the skin is **breached** by a cut) the inflammatory response occurs.

Heat and cold receptors are located in the skin. When the body temperature rises, the hypothalamus sends a nerve signal to the sweat-producing skin glands, causing them to release about 1-2 liters of water per hour, cooling the body. The hypothalamus also causes **dilation** of the blood vessels of the skin, allowing more blood to flow into those areas, causing heat to be conducted away from the skin surface. When body temperature falls, the sweat glands **constrict** and sweat production decreases. If the body temperature continues to fall, the body will engage in thermogenesis, or heat generation, by raising the body's **metabolic rate** and by **shivering**.

Water loss occurs in the skin by two routes.

1. evaporation
2. sweating

In hot weather up to 4 liters per hour can be lost by these mechanisms. Skin damaged by burns is less effective at preventing fluid loss, often resulting in a possibly life threatening problem if not treated.

### **Skin and Sensory Reception**

Sensory receptors in the skin include those for pain, pressure (touch), and temperature. Deeper within the skin are Meissner's **corpuscles**, which are especially common in the tips of the fingers and **lips**, and are very sensitive to touch. Pacinian corpuscles respond to pressure. Temperature receptors: more cold ones than hot ones.

### **Skin and Synthesis**

Skin cells synthesize melanin and carotenes, which give the skin its color. The skin also assists in the synthesis of vitamin D. Children lacking sufficient vitamin D develop bone abnormalities known as **rickets**.

### **Skin Is Selectively Permeable**

The skin is selectively **soluble** to fat-soluble substances such as vitamins A, D, E, and K, as well as steroid hormones such as estrogen. These substances enter the bloodstream through the capillary networks in the skin. **Patches** have been used to deliver a number of therapeutic drugs in this manner. These include estrogen, scopolamine (motion sickness), nitroglycerin (heart problems), and nicotine (for those trying to quit smoking).