

The Integumentary System

The integumentary system, formed by the skin, hair, nails, and associated glands, enwraps the body. It is the most visible organ system and one of the most complex. The integumentary system protects the body from the outside world and its many _____ substances. It utilizes the Sun's rays while at the same time shielding the body from their damaging effects. In addition, the system helps to regulate body _____, serves as a minor excretory organ, and makes the inner body aware of its outer _____ through sensory receptors.

Integument comes from the Latin word *integumentum*, meaning "_____" or "enclosure." The human integumentary system is an external body covering, but also much more. It _____, nourishes, insulates, and cushions. It is absolutely essential to life. _____ it, an individual would be attacked immediately by bacteria and die from heat and water loss.

Skin

Although the skin is not often thought of as an organ, such as the heart or liver, medically it is. An organ is any part of the body formed of two or more tissues that performs a specialized _____. As an organ, the skin is the largest and heaviest in the body. In an average adult, the skin covers about 2 square meters and accounts for approximately 7 percent of body weight, or about 5 kilograms in a 73-kilogram person. It ranges in thickness from 1 to 2 millimetres, but can measure up to 6 millimetres thick on the _____ of the hands and the _____ of the feet. The skin in these areas is referred to as thick skin (skin elsewhere on the body is called _____ skin).

The skin has two principal _____: the epidermis and the dermis. The epidermis is the thin, _____ layer, and the dermis is the thicker, inner layer. Beneath the dermis lies the subcutaneous layer or _____, which is composed of fatty tissue. Although not technically part of the skin, it does anchor the skin to the underlying muscles. It also contains the major blood _____ that supply the dermis and houses many white blood cells, which destroy foreign invaders that have _____ the body through breaks in the skin.

EPIDERMIS. The epidermis is made of stratified *squamous* epithelial tissue. Epithelial tissue covers the internal and external surfaces of the body and also forms glandular organs. Squamous cells are thin and flat like fish scales. Stratified simply means having two or more layers. In short, the epidermis is _____ of many layers of thin, flattened cells that fit closely together and are able to withstand a good deal of abuse or friction.

The epidermis can be _____ into four or five layers. Most important of these are the inner and outer layers. The inner or deepest cell layer is the only layer of the epidermis that receives nutrients (from the underlying dermis). The cells of this layer, called *basal* cells, are constantly dividing and creating new cells daily, which _____ the older cells toward the surface. Basal cells produce keratin, an extremely durable and water-resistant fibrous protein.

Another type of cell found in the lower epidermis is the melanocyte. Melanocytes produce melanin, a protein _____ that ranges in colour from yellow to brown to black. The amount of melanin produced determines skin colour, which is a hereditary characteristic. The melanocytes of dark-skinned individuals continuously produce large amounts of melanin. Those of light-skinned individuals produce less. Freckles are the result of melanin clumping in one spot.

The outermost layer of the epidermis consists of about twenty to thirty rows of tightly joined flat dead cells. All that is left in these cells is their keratin, which makes this outer layer _____. It takes roughly fourteen days for cells to move from the inner layer of the epidermis to the outer layer. Once part of the outer layer, the dead cells remain for another fourteen days or so before flaking off slowly and steadily.

DERMIS. The dermis, the second layer of skin, lies between the epidermis and the _____ layer. Much thicker than the epidermis, the dermis contains the accessory skin structures. Hair, _____ glands, and _____ (oil) glands are all rooted in the dermis. This layer also contains blood vessels and nerve fibres. Nourished by the blood and oxygen provided by these blood vessels, the cells of the dermis are alive.

Connective tissue forms the dermis. Bundles of elastic and collagen (tough fibrous protein) fibres blend into the connective tissue. These fibres provide the dermis strength and flexibility.

The upper layer of the dermis has finger like projections that extend into the epidermis. Called dermal papillae, they contain blood capillaries that provide nutrients for the basal cells in the epidermis. On the skin surface of the hands and feet, especially on the tips of the fingers, thumbs, and toes, the dermal papillae form looped ridges. These print patterns, known as fingerprints or toeprints, increase the gripping ability of the hands and feet. Genetically determined, the patterns are _____ to every individual.

Accessory structures

The accessory structures of the integumentary system include hair, nails, and sweat and sebaceous glands.

HAIR. Roughly 5 million hairs cover the body of an average individual. About 100,000 of those hairs appear on the _____. Almost every part of the body is covered by hair, except the palms of the hands, the soles of the feet, the sides of the fingers and toes, the lips, and certain parts of the outer genital organs.

Each hair originates from a tiny tubelike structure called a hair _____ that extends deep into the dermis layer. Often, the follicle will project into the subcutaneous layer. Capillaries and nerves attach to the base of the follicle, providing nutrients and sensory information. Inside the base of the follicle, epithelial cells grow and divide, forming the hair bulb or enlarged hair base. _____, the primary component in these epithelial cells, coats and stiffens the hair as it grows upward through the follicle. The part of the hair enclosed in the follicle is called the hair _____. Once the hair projects from the scalp or skin, it is called a hair _____.

The older epithelial cells forming the hair root and hair shaft die as they are _____ upward from the nutrient-rich follicle base by newly formed cells. Like the upper layers of the epidermis, the hair shaft is made of dead material, almost entirely protein. The hair shaft is divided into two layers: the cuticle or outer layer consists of a single layer of flat, overlapping cells; the cortex or inner layer is made mostly of keratin.

Hair shafts differ in size, shape, and colour. In the eyebrows, they are short and stiff, but on the scalp they are longer and more flexible. Elsewhere on the body they are nearly invisible. Oval-shaped hair shafts produce wavy hair. Flat hair shafts produce curly hair. Perfectly round hair shafts produce straight hair. The different types of melanin—yellow, rust, brown, and black—produced by _____ at the follicle base combine to create the many varieties of hair colour, from the palest blonde to the richest black. With age, the production of melanin _____, and hair colour turns gray.

Attached to each hair follicle is a ribbon of smooth muscle called a hair _____ muscle. When stimulated, the muscle contracts and pulls on the follicle, causing the hair shaft to stand upright.

NAILS. Nails in humans correspond to the hooves of horses and cattle and the claws of birds and reptiles. Found on the ends of fingers and toes, nails are produced by nail follicles just as hair is produced by hair follicles. The nail root is that portion of the nail embedded in the skin, lying very near the bone of the fingertip. Here, cells produce a stronger form of keratin than is found in hair. As new cells are formed, older cells are pushed forward, forming the nail body or the visible attached portion of the nail. The free edge is that portion of the nail that extends over the _____ of the finger or toe. Healthy fingernails grow about 1 millimetre per week, slightly faster than toenails.

The nail body is made of dead cells, but the nail _____ (the tissue underneath the nail body) is alive. The blood vessels running through the nail bed give the otherwise transparent nail body a _____ colour. Near the nail root, however, these blood vessels are obscured. The resulting white crescent is called the _____ (from the Latin word *luna*, meaning "moon").

SWEAT GLANDS. More than 2.5 million sweat glands are distributed over most surfaces of the human body. They are divided into two types: eccrine sweat glands and apocrine sweat glands.

Eccrine glands, the more numerous of the two types, are found all over the body. They are especially numerous on the forehead, upper lip, palms, and soles. The glands are simply tubes that originate in the dermis. A duct extends from the gland to the skin's surface, where it opens into a _____. Eccrine glands produce sweat or _____, a clear secretion that is 99 percent water. Some salts, traces of _____ materials such as urea, and vitamin C form the remainder (the salts give sweat its characteristic salty taste).

Depending on temperature and humidity, an average individual loses 0.3 to 0.8 litres of water every day through sweating. During rigorous physical activity or on a hot day, that amount could rise to 5 to 7 litres.

Apocrine glands are found in the armpits, around the nipples, and in the groin. Like eccrine glands, apocrine glands are tubes found in the dermis. However, they are usually larger and their ducts empty into hair follicles. Also, apocrine glands do not function until puberty. At that time, they begin to _____ an odourless cloudy secretion that contains fatty acids and protein. If the secretion of apocrine glands is allowed to _____ on the skin for any length of time, bacteria that lives on the skin breaks down the fatty acids and protein for their growth, creating the unpleasant odor often associated with sweat. Apocrine glands are activated by nerve fibres during periods of pain and stress, but their function in humans is not well understood. Scientists theorize they may act as sexual attractants.

SEBACEOUS GLANDS. Sebaceous glands, also known as _____ glands, are found in the dermis all over the body, except for the _____ and _____. They _____ sebum, a mixture of lipids (fats), proteins, and fragments of dead fat producing cells. The function of sebum is to prevent the _____ of skin and hair. It also contains chemicals that kill bacteria present on the skin surface. While most sebaceous glands secrete sebum through ducts into hair _____, some secrete sebum directly onto the surface of the skin. Erector muscles, which contract to elevate hairs, also _____ sebaceous glands, forcing out sebum.