

Anatomy and Physiology

4. The Integumentary System



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The Integumentary System

Tour of the System

The integumentary system is composed of the skin, hair and nails. It has a variety of functions, but the main one is to protect the body. It is the largest organ system in the body, consisting of around 15% of the total body weight.

The skin is a key indicator of an individual's health status. It is readily visible, without any intrusive procedures. The skin of the face and hands can reveal a lot about the circulatory system, the lifestyle of the patient and their general health. Those who have yellowing skin are usually suffering from jaundice whereas those who have a blue-grey tint are suffering from cyanosis. A deep red hue could show hypertension (high blood pressure) or white skin can be an indicator of medical shock. How skin feels can also show disease or trauma. Skin may feel cold, clammy, hot or dry.

Functions

The skin **protects internal tissues and organs**.

The skin **prevents organisms** (such as bacteria or viruses) from entering the body.

The skin **protects the body from dehydrating**.

The skin **acts as a waterproof barrier**. It allows a wet body to exist in dry air, allows immersion in fresh water without swelling with water, or immersion in salt water without becoming desiccated.

The skin **protects the body from sudden temperature changes** (maintains homeostasis). On hot days, the skin helps regulate body temperature in three main ways:

Arterioles vasodilate and send more blood to superficial capillaries in the skin. This allows heat loss.

The hairs on the skin remain flat, preventing the insulating air from becoming trapped between the hairs and the skin.

Sweating or perspiration is also essential for cooling the body, through the process of evaporation.

The skin **protects the body from UV damage** by secreting melanin. Pigmented or freckled skin is an adaptation to intense sunlight.

The skin **excretes waste materials**, such as salts and urea, through perspiration.

The skin **stores a variety of substances** include water, fat, glucose and vitamin D.

The skin **produces Vitamin D** from UV exposure. An absence of Vitamin D causes rickets.

The skin **forms new skin cells** to repair skin damage.

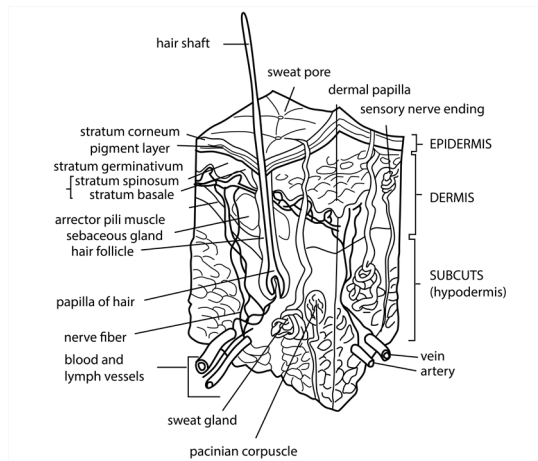
The skin **maintains the form** of the body.

The **skin acts as a receptor** for:

- touch
- pressure
- pain
- heat
- cold

These receptors are also parts of the *somatosensory system*. Because the skin receives many stimuli, it plays a major role in man's adaptation to his environment. In particular, the skin acts as an early warning system for unhealthy conditions.

Components



Skin consists of two main layers, the epidermis and the dermis and these contain sev-

eral other components:

The Epidermis

This is the top layer of skin made up of epithelial cells.

The cells lower in the epidermis are responsible for the growth of this layer. As mitosis (cell division) occurs at the *basale layer*, cells move up through the strata (thin layer), pushed upwards by the dividing cells below.

The epidermis does not contain blood vessels.

There are several different types of cell found in the epidermis, including keratinocytes and melanocytes.

Keratinocytes are the most common cell found in the epidermis.

Keratinocytes mainly act as a barrier cell. They also produce a protein known as *keratin*.

Keratin makes the top layer strong and water resistant.

As production of keratin increases, the keratinocytes die, called *cornification*.

These cornified keratinocytes are then lost (or shed) from the surface of the skin and replaced with new cells.

Renewal of the epidermis, also known as the process of maturation and desquamation takes around 21 days.

Nails develop in the epidermis and extend down into the dermis.

The Dermis

This contains a variety of connective tissues such as collagen and elastin that give skin stretch and flexibility.

The dermis helps cushion the body from stresses.

Ends of blood vessels and nerves are located in the dermis.

The blood vessels nourish and remove waste from the dermis and the basale layer of the epidermis.

The base of sweat glands and sebaceous glands are also located in the dermis.

Hair follicles may extend down into the underlying connective tissue, but they originally arise from the epidermis.

Sweat glands

Sweat glands are small tubular structures of the skin that produce sweat.

Eccrine sweat glands are all over the body. These play a key role in perspiring and cooling the skin

Apocrine sweat glands are larger and limited to the armpits and perianal areas. These become active during puberty and secrete odorous sweat.

Hair

The functions of hair include warmth and protection. In animals, hair has many other important functions such as camouflage.

Hair develops from keratin and it grows from the hair follicles that arise from the epidermis.

Once hair leaves the follicle, it is 'dead'.

Attached to the hair follicle is a sebaceous gland that lubricates the hair and the *erector pili* muscle that cause hair to stand up (goose bumps).

Nails

Nails protect the delicate fingertip from injury and help with delicate finger movements.

The condition of nails is also a good indicator of general health.

A nail consists of a nail plate, nail matrix and nail bed.

Nail plate cells grow in the *cell matrix* and push older nail plate cells forward.

The nail plate is the actual nail and this is made of keratin, forming a strong flexible material composed of layers of dead cells.

The *nail bed* is similar in structure to the skin, containing a dermis and epidermis.

Hypodermis

The *hypodermis* or *subcutaneous layer* is often associated with the skin. Its main function is to attach the skin to bone and muscle and supply the skin with blood vessels and nerves.

The main cells contained within the hypodermis are fibroblasts, macrophages and adipocytes (fat cells).

The hypodermis contains 50% of body fat and is essential as padding and insulation for the body.

Common Diseases and Disorders

Allergic reactions: The skin will often respond with a red rash due to exposure to an allergen. An allergen can be swallowed, inhaled, injected or even touched. Common allergens include, stings and animal fur.

Boil: A boil or furuncle develops from bacterial infection of the hair follicle.

Carcinomas: This is the medical term for cancer. The skin is subject to several kinds of carcinomas: basal cell, squamous cell carcinomas, as well as melanomas.

- Basal cell carcinoma is the most common type of skin cancer. Although it rarely kills, it is considered malignant as it can cause a lot of damage as it invades surrounding tissues.
- Squamous cell carcinoma is also a common cancer and can develop on the skin and other parts of the body. The cells involved in this type of carcinoma continue to divide uncontrollably.

A melanoma is a malignant tumor made up of melanocyte cells (which produce the pigment melanin). Many melanomas are visible as changes to existing moles or the appearance of a new lesion on the skin.

Cysts: If a sebaceous gland is blocked, a cyst can form. Because a cyst is enclosed, when it grows it displaces other structures around it. It does not invade other tissues (noninvasive).

Dermatitis: Sometimes used interchangeably with eczema. Dermatitis is inflammation of the skin of which there are several causes. Contact dermatitis often occurs on the hands as a reaction to latex gloves or chemicals.

Eczema: This condition has scaly, itchy patches with blisters.

Impetigo: A contagious bacterial infection of the skin that is very common amongst children

Pimples: When sebaceous glands are blocked, their oily discharge (sebum) accumulates under the skin, causing a small swelling. These often become infected.

Psoriasis: This is a skin disorder characterized by scaly red patches of the skin. When this disorder affects the fingers, it can cause nails to become deformed.

Pustules: These are common in acne. Pustules are small, inflamed and pus-filled lesions on the surface of the skin. They can occur anywhere on the body but are common on the face, shoulders and back.

Rash: Allergic reactions and several illnesses manifest with a skin rash. Nearly all “childhood diseases” such as measles and chicken pox have a skin rash. With these types of disease, often the rash provides the final diagnosis, even before the bacterial analyses are completed.

Medical Terminology

Basale layer: The lowest layer of the epidermis, this is the layer where epidermal cell division occurs.

Cyanosis: Also called 'blue disease,' this is a discoloration of the skin caused by low oxygen levels in tissues near the surface of the skin.

Homeostasis: This is the ability of the human body to maintain a stable internal environment, when dealing with both internal and external environmental changes.

Keratin: This protein has several functions in the skin, including, waterproofing.

Keratinocytes: These cells produce keratin.

Melanin: The pigment found in skin and hair that are the primary determinants of color.

Melanocytes: These cells produce melanin.

Vasodilation: This is when smooth muscle, found in arteries, arterioles and large veins relaxes to allow an increased flow of blood through. This plays an important role in controlling body temperature.

Vasoconstriction: The opposite of vasodilation, this occurs when blood vessels narrow, restricting the quantity of blood that can flow through these vessels.

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