

Lec1

Human physiology

Main Topic

- What mean physiology
- What is the skin and it s appendages
- Skin Components and Functions
- Nutrition for healthy skin
- Component of skin appendages

Physiology is the scientific study of normal function in living systems. its focus is in how organisms, organ systems, organs, cells, and bio-molecules carry out the chemical or physical functions that exist in a living system Given the size of the field it is divided into, among others, animal physiology (including that of human), plant physiology, cellular physiology, microbial physiology, bacterial physiology, and viral physiology

Human physiology

Human physiology seeks to understand the mechanisms that work to keep the human body alive and functioning, through scientific enquiry into the nature of mechanical, physical, and biochemical functions of humans, their organs, and the cells of which they are composed. The principal level of focus of physiology is at the level of organs and systems within systems. The endocrine and nervous systems play major roles in the reception and transmission of signals that integrate function in animals.

The biological basis of the study of physiology, integration refers to the overlap of many functions of the systems of the human body, as well as its accompanied form. It is achieved through communication that occurs in a variety of ways, both electrical and chemical.

- **Human skin**

The **human skin** is the outer covering of the body. In humans, it is the largest organ of the integumentary system. The skin has multiple layers of ectodermic tissue and guards the underlying muscles, bones, ligaments and internal organs.

Human skin is similar to that of most other mammals, except that it is not protected by a fur. Though nearly all human skin is covered with hair follicles, it can appear hairless. There are two general types of skin, hairy and glabrous skin.

Skin Components

Skin has mesodermal cells, pigmentation, or melanin provided by melanocytes, which absorb some of the potentially dangerous ultraviolet radiation (UV) in sunlight. It also contains DNA- repair enzymes that help reverse UV damage, such that people lacking the genes for these enzymes suffer high rates of skin cancer.

One form predominantly produced by UV light, malignant melanoma, is particularly invasive, causing it to spread quickly, and can often be deadly. Human skin pigmentation varies among populations in a striking manner. This has led to the classification of people(s) on the basis of skin color.

▪ **Functions**

Skin performs the following functions:

1. **Protection:** an anatomical barrier from pathogens and damage between the internal and external environment in bodily defense; Langerhans cells in the skin are part of the adaptive immune system.
2. **Sensation:** contains a variety of nerve endings that react to heat and cold, touch, pressure, vibration, and tissue injury; see soma to sensory system and haptics.
3. **Heat regulation:** the skin contains a blood supply far greater than its requirements which allows precise control of energy loss by radiation, convection and conduction.
4. **Control of evaporation:** the skin provides a relatively dry and semi-impermeable barrier to fluid loss. Loss of this function contributes to the massive fluid loss in burns.
5. **Aesthetics and communication:** others see our skin and can assess our mood, physical state and attractiveness.
6. **Storage and synthesis:** acts as a storage center for lipids and water, as well as a means of synthesis of vitamin D by action of UV on certain parts of the skin.
7. **Excretion:** sweat contains urea, however its concentration is 1/130th that of urine, hence excretion by sweating is at most a secondary function to temperature regulation.

▪ **Pigments**

There are at least five different pigments that determine the color of the skin. These pigments are present at different levels and places.

- **Melanin:** It is brown in color and present in the germinative zone of the epidermis.
- **Melanoid:** It resembles melanin but is present diffusely throughout the epidermis.

- **Keratin:** This pigment is yellow to orange in color. It is present in the stratum corneum and fat cells of dermis and superficial fascia.
- **Hemoglobin :** It is found in blood and is not a pigment of the skin but develops a purple color.
- **Oxyhemoglobin:** It is also found in blood and is not a pigment of the skin. It develops a red color.

Skin layers

Skin is composed of three primary layers:

- the **epidermis**, which provides waterproofing and serves as a barrier to infection;
 - the **dermis**, which serves as a location for the appendages of skin; and
 - the **hypodermis** (*subcutaneous adipose layer*).
- ❖ **Epidermis:** is the outermost layer of the skin. It forms the waterproof, protective wrap over the body's surface and is made up of stratified squamous epithelium with an underlying basal lamina.

Components

The epidermis contains no blood vessels, and is nourished by diffusion from the dermis. The main type of cells which make up the epidermis are keratinocytes, melanocytes, Langerhans cells and Merckels cells. The epidermis helps the skin to regulate body temperature.

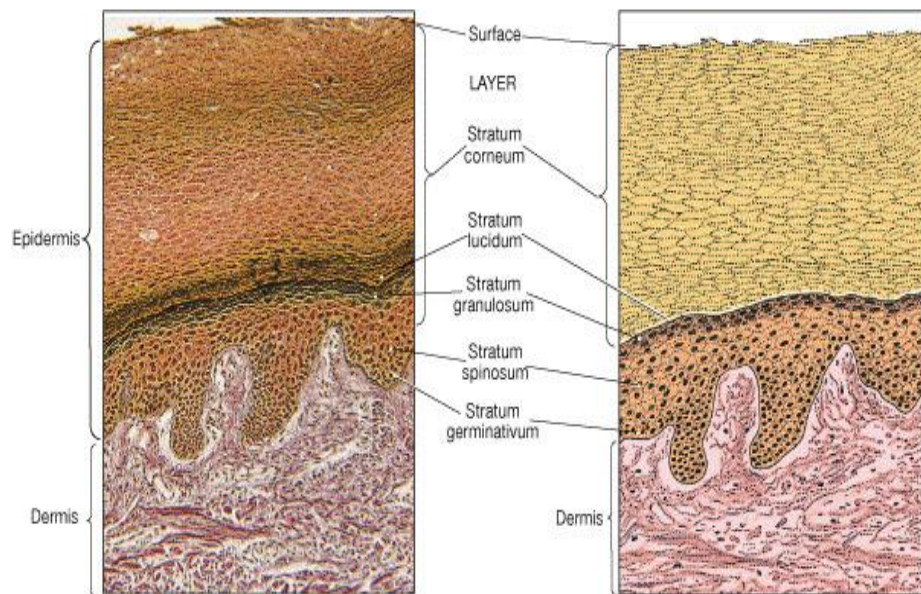
Epidermis Layers

Epidermis is divided into several layers where cells are formed through mitosis at the innermost layers. They move up the strata changing shape and composition as they differentiate and become filled with keratin. They eventually reach the top layer are start with **Stratum Corneum** ,**Stratum Lucidum** ,**Stratum Granulosum** ,**Stratum Mucosum** and **Stratum Germinativum**.

➤ The Corneum layer is the top layer of your skin. This is the layer you can see. Here the cells are dead and continually flake off the surface.

➤ The Lucidum layer is only found on the palms of your hands and soles of your feet. This is the layer that thickens to fight mechanical attack.

➤ The Granulosum layer is where the cells are found with small granules in them, thought to make the skin tough. Your lips and skin under fingernails do not have this layer in them.



➤ The Mucosum layer is where tissue fluid is stored

➤ The Germinativum layer is the bottom layer and here the cells are constantly reproducing. The melanocyte cells are also located in this layer.

❖ Dermis

The dermis also varies in thickness depending on the location of the skin. It is .3 mm on the eyelid and 3.0 mm on the back. The dermis is composed of three types of tissue that are present throughout - not in layers. The types of tissue are:

- collagen
- elastic tissue
- reticular fibers

Layers of the Dermis

The two layers of the dermis are the papillary and reticular layers.

- The upper, papillary layer, contains a thin arrangement of collagen fibers.

- The lower, reticular layer, is thicker and made of thick collagen fibers that are arranged parallel to the surface of the skin.

Specialized Dermal Cells

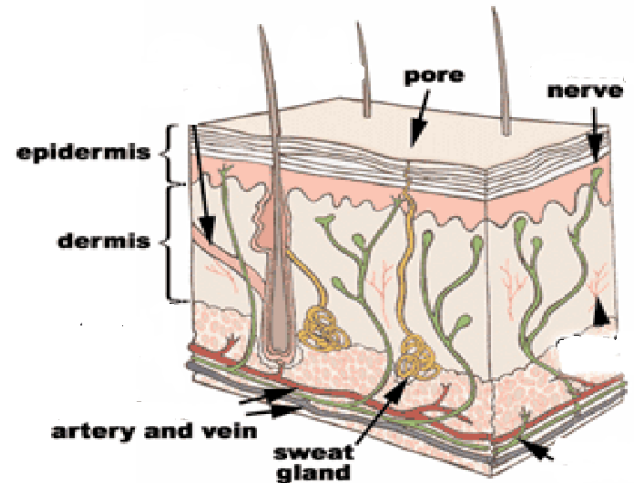
The dermis contains many specialized cells and structures.

-The hair follicles are situated here with the erector pili muscle that attaches to each follicle.

-Sebaceous (oil) glands and apocrine (scent) glands are associated with the follicle.

-This layer also contains sweat glands, but they are not associated with hair follicles.

-Blood vessels and nerves course through this layer. The nerves transmit sensations of pain, itch, and temperature.

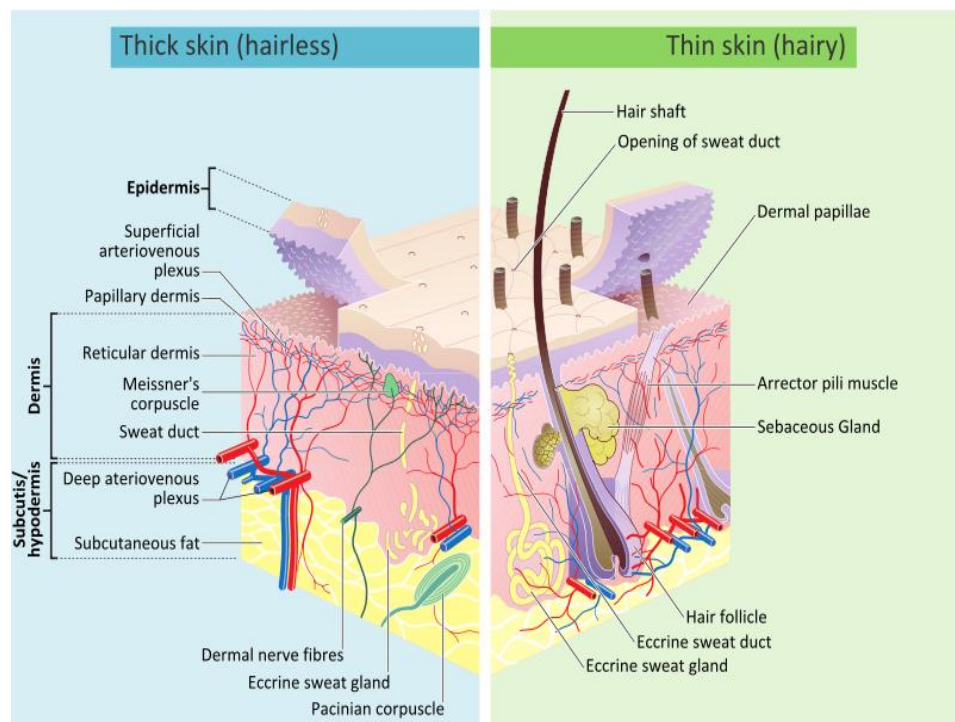


❖ *hypodermis (subcutaneous adipose layer).*

- Adipose tissue
- Also contains Pacinian corpuscles

• **Functions:**

- Insulation
- Shock absorption
- Anchors skin to underlying organs



(Skin layers, of both hairy and hairless skin)

Nutrition for healthy skin

Vitamin A, also known as retinoids, benefits the skin by normalizing keratinization, downregulating sebum production which contributes to acne, and reversing and treating photodamage, striae, and cellulite.

Vitamin D and analogs are used to downregulate the cutaneous immune system and epithelial proliferation while promoting differentiation.

Vitamin C is an antioxidant that regulates collagen synthesis, forms barrier lipids, regenerates vitamin E, and provides photoprotection.

Vitamin E is a membrane antioxidant that protects against oxidative damage and also provides protection against harmful UV rays.

- **Skin appendages**

Skin appendages are skin-associated structures that serve a particular function including sensation, lubrication and heat loss. Skin appendages include hairs and hair follicles, nails, sweat glands, and sebaceous glands. Each is derived from the epidermis and has a unique role in maintaining body homeostasis.

The commonly seen skin appendages are:

- Hair follicles
- Sweat glands
- Sebaceous glands
- Nails

- **Hairs and Hair Follicles:-**

Distributed over nearly the entire body surface and has some minor protective functions, such as guarding the head against physical trauma, heat loss, and sunlight. Eyelashes shield the eyes and nose hairs help keep dust and other foreign particles out of the respiratory tract.

Types of hair

Humans have three different types of hair :

- Lanugo, the fine, unpigmented hair that covers nearly the entire body of a fetus, although most has been replaced with vellus by the time of the baby's birth

- Vellus hair, the short, downy, "peach fuzz" body hair (also unpigmented) that grows in most places on the human body. While it occurs in both sexes, and makes up much of the hair in children, men have a much smaller percentage (around 10%) vellus whereas 2/3 of a female's hair is vellus.
- Terminal hair, the fully developed hair, which is generally longer, coarser, thicker, and darker than vellus hair, and often is found in regions such as the axillary, male beard, and pubic.

Structure:

Flexible strand-like structure produced by the hair follicle. Consists largely of fused keratinized cells. Chief regions of a hair are: shaft and root. Shape of the shaft determines the shape of the hair.

Hair pigment

Is made by melanocytes at the base of the hair follicle. Different proportions of melanin lead to different colors (yellow, black, brown). They combine to produce all varieties of hair color. Gray or white hair results from a decrease in melanin production and the replacement of melanin by air bubbles in the hair shaft.

Hair Follicle

Extends from the epidermal surface to the dermis. The deep end of the follicle is expanded forming a bulb. A knot of sensory nerve endings (root hair plexus) wraps around the bulb. Hair acts as sensitive touch receptors.

Distribution

Millions of hairs are scattered over nearly all the body. Only the lips, nipples, parts of the external genitalia, and the thick skin areas of the palms and soles lack hair.

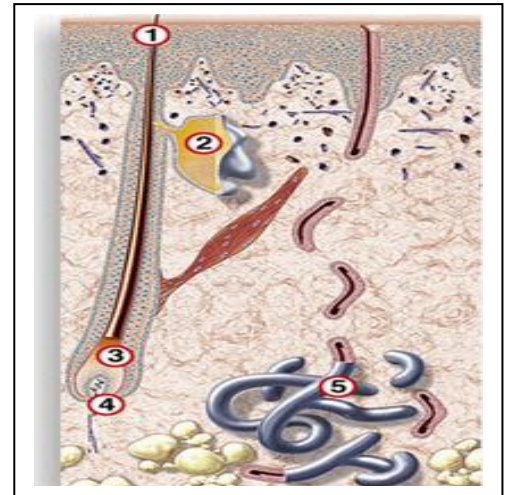
Hair growth and density are influenced by many factors including nutrition and hormones. Rate of growth varies with sex and age. Averages 2mm/week. Each follicle goes through growth cycles (active growth & rest). Life span varies. The follicles of the scalp remain active for years before becoming inactive for a few months. The eyebrows remain active for only 3-4 months.

Pathological impacts on hair

Drugs used in cancer chemotherapy frequently cause a temporary loss of hair, noticeable on the head and eyebrows, because they kill all rapidly dividing cells, not just the cancerous ones. Other diseases and traumas can cause temporary or permanent loss of hair, either generally or in patches.

Schematic diagram of the follicle. The hair follicle and sebaceous gland form a structural and functional unit.

- 1 Hair shaft
- 2 Sebaceous gland
- 3 Bulbus
- 4 Hair papillae
- 5 Sweat gland



- **Sweat Glands**

More than 2.5 million sweat glands are distributed over the entire body. Two types of sweat glands: eccrine and apocrine.

Eccrine Sweat Glands

Eccrine sweat glands are found in nearly all body regions more numerous especially on the palms, soles and forehead. They secrete a hypotonic solution (sweat) derived from blood plasma. It is 99% water with some other substances in it. Sweating is regulated by the sympathetic nervous system. And assists in thermoregulation.

Human eccrine sweat is composed chiefly of water with various salts and organic compounds in solution. It contains minute amounts of fatty materials, urea, and other wastes. The concentration of sodium varies from 35–65 mmol/l and is lower in people acclimatised to a hot environment. The sweat of other species generally differ in composition.

Apocrine Sweat Glands

Apocrine glands are only found in largely confined to the axillary and perineal regions. They are larger in size. The secretions are the same as eccrine with the addition of fatty substances and proteins which make the secretions viscous. The secretions are odorless until bacterial decomposition occurs. Precise function unknown. Activated by the sympathetic nervous system during pain or stress. Apocrine glands typically empty into hair follicles. Emotional stress increases the production of sweat from the apocrine glands, or more precisely: the sweat already

present in the tubule is squeezed out. Apocrine sweat glands essentially serve as scent glands.

- **Sebaceous (oil) Glands**

Simple glands found all over the body except on the palms and soles. They are small on the body trunk and limbs and larger on the face, neck, and upper chest. Secrete an oily secretion called sebum. The sebum is usually ducted into a hair follicle. Sebum softens and lubricates the hair and skin and it has a bactericidal action..

Sebum is odorless, but its bacterial breakdown can produce odors. Sebum is the cause of some people experiencing "oily" hair if it is not washed for several days. Earwax is partly sebum, as is mucopurulent discharge, the dry substance accumulating in the corners of the eye after sleeping.

The activity of the sebaceous glands increases during puberty because of heightened levels of androgens.

Sebaceous glands are involved in skin problems such as acne and keratosis pilaris. A blocked sebaceous gland can result in a sebaceous cyst. The prescription drug isotretinoin significantly reduces the amount of sebum produced by the sebaceous glands, and is used to treat acne. The extreme use (up to 10 times doctor prescribed amounts) of anabolic steroids by bodybuilders to prevent weight loss tend to stimulate the sebaceous glands which can cause acne. Acne is an active inflammation of the glands accompanied by "pimples." Acne is usually caused by bacteria, especially staphylococcus

- **Nails**

Scale-like modifications of the epidermis that forms a clear protective covering on the dorsum of the distal part of a finger or toe. Each nail has a free edge, a body, and a root embedded in the skin. The thickened proximal part of the nail bed - nail matrix - is responsible for nail growth. Nail cells are heavily keratinized. Nail body slides distally over the nail bed during growth.

Nail Diseases

Nail diseases are in a separate category from diseases of the skin. Although nails are a skin appendage, they have their own signs and symptoms which may relate to other medical conditions. Nail conditions that show signs of infection or inflammation

require medical assistance and cannot be treated at a beauty parlor. Deformity or disease of the nails may be referred to as onychosis.

There are many disease that can occur with the fingernails and toenails. The most common of these diseases are ingrown nails and fungal infections.

