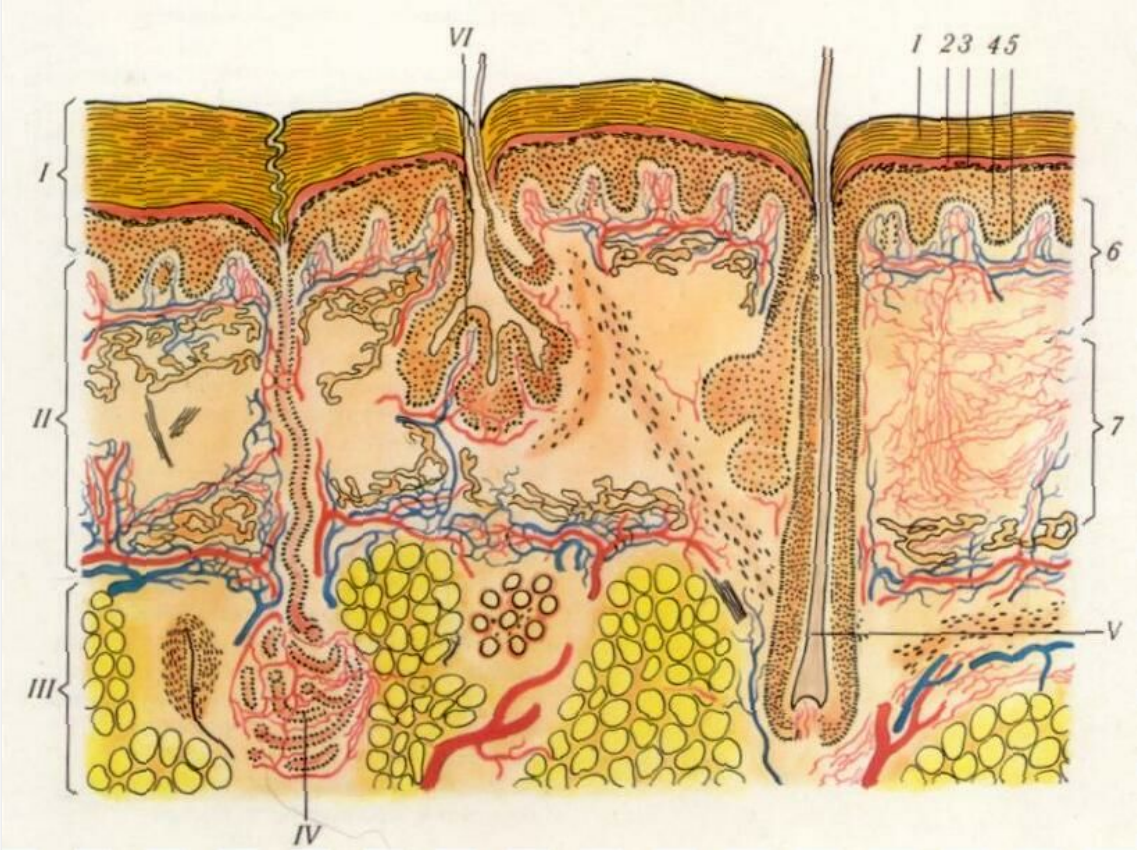
Lection 1
Anatomy Of The Skin

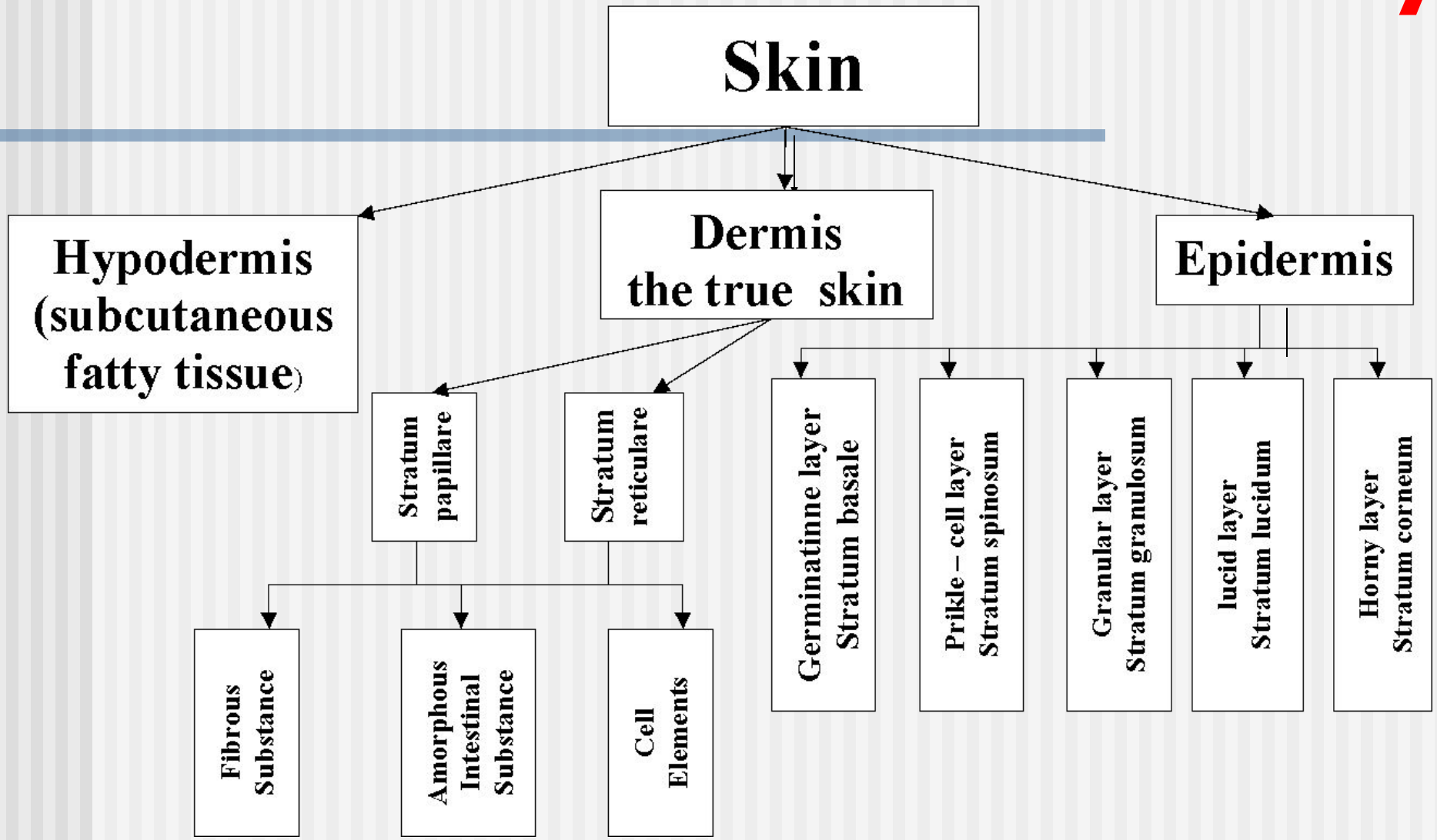
I. Epidermis
I. Dermis
I. Hypodermis
V. Appendixes of the skin.
1. Stratum basale
2. Stratum spinosum
3. Stratum granulosum
4. Stratum lucidum
5. Stratum corneum



Skin Anatomy

- The skin is an organ that forms a protective barrier against germs (and other organisms) and keeps the inside of your body inside your body, and keeps what's outside of your body outside. Skin also helps maintain a constant body temperature. Human skin is only about 0.07 inches (2 mm) thick.
- Skin is made up of two layers that cover a third fatty layer. The outer layer is called the epidermis; it is a tough protective layer that contains melanin (which protects against the rays of the sun and gives the skin its color). The second layer (located under the epidermis) is called the dermis; it contains nerve endings, sweat glands, oil glands, and hair follicles. Under these two skin layers is a fatty layer of subcutaneous tissue (the word subcutaneous means "under the skin").
- On average, an adult has from 18-20 square feet (about 2 square meters) of skin, which weighs about 6 pounds (2.7 kg).

Skin Anatomy

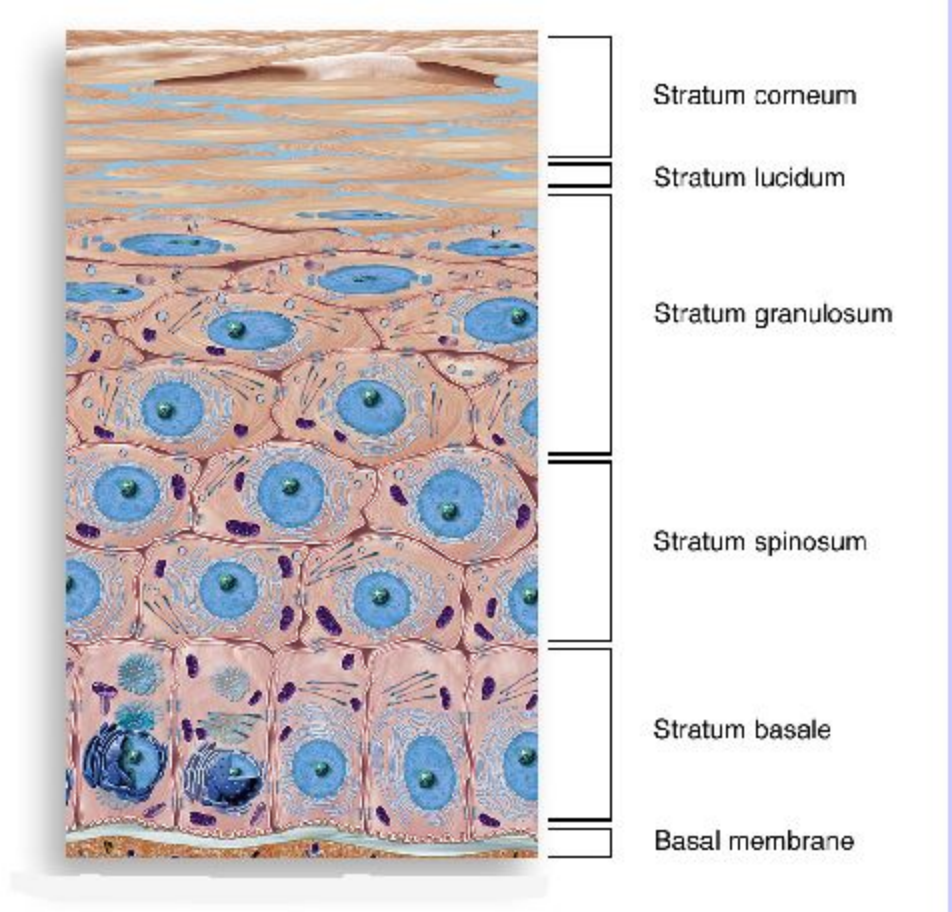


Epidermis and it's layers

- The epidermis is the most superficial layer of the skin and provides the first barrier of protection from the invasion of foreign substances into the body. The principal cell of the epidermis is called a keratinocyte. The epidermis is subdivided into five layers or strata, the stratum germinativum (**SG**), the stratum spinosum(**SS**), the stratum granulosum(**SGR**), the stratum lucidum), the stratum lucidum and the stratum corneum(**SC**) in which a keratinocyte gradually migates to the surface and is sloughed off in a process called desquamation.

Epidermis and it’s layers

- The epidermis, the outermost skin layer, consists of five different layers:
- • Stratum corneum
- • Stratum lucidum
- • Stratum granulosum
- • Stratum spinosum
- • Stratum basale



Layer	Consistence	Function
1.Stratum basale (germinative layer)	1. keratinoblastis (1 layer, like a polisade). 2.Melanoblastis (their ratio is 1:11).	1. young cells, are devided by mitosis, and form all the structures of epidermis. 2. Melanin is formed in the melanoblastis and protects the skin from ultraviolet rays.
2. Stratum spinosum (pricle-cell layer	1. Dendritic epidermocytis (5-7 layers) 2. Langhan's cells 3. Hrenstayin's cells	1. Cytoplasmatic dentricals akanthos provide the connection of cells with the other cells. Intercellular fluid cerculates through these canals. This cells produce interleukins. Immunological (protective) cells.
3. Stratum granulosum (granular layer	1-2 layers of elongated cells. There are keratohya-linis granuls in the protoplasm of these cells.	The beginning of hornysation (keratinisation) but mitosis is present.
4. Stratum lucidum (lucid layer)	These cells contain eleidin. Str. lucidum contains glycogens, lipoids, fatty acids.	Protective function. This layers does not allow water mild acid solution, alkalines, electrolites to penetrate in.
5. Stratum corneum (horny layer)	It is composed of fine, anuclear keratinised elongated cells containing keratin.	Keratinisation take an active part in the skin protection from penetration into the it microorganisms and harmful substanses.

Several cell types constitute epidermis.

Keratinocytes These epithelial cells comprise the majority of the epidermal cells. They are called keratinocytes because of the fibrous proteins, keratins, which are the differentiated end-product of these cells. Only the keratinocytes of the basal layer divide, and the daughter cells migrate upwards and change from cuboidal in appearance to squames. Eventually, the keratinocytes lose their nuclei and become anuclear, compact, protein-dense cells that occupy the outermost horny cell layer, the stratum corneum. Cells of the stratum corneum ultimately desquamate. Normally, the rate of desquamation equals the rate of the formation of the cells in the basal layer. In certain dermatologic diseases, like psoriasis, there is increased turnover of epidermal keratinocytes. Keratinocytes attach to each other by structures called desmosomes. Damage to these structures result in separation of the keratinocytes.

Several cell types constitute epidermis.

The stratum corneum of the epidermis is responsible for the most important function of the skin, namely its protective barrier function. The mechanism by which such protection is conferred is complex and involves the function of intracellular fibrous proteins, dense cellular membranes, and intercellular lipid constituents. The intercellular lipid portion is now believed to be the crucial component responsible for barrier function. Keratinocytes also play a role in immune responses through the production of a variety of cytokines.

The skin is not completely impermeable. Compounds can pass through intact skin. This permeability of the skin is used for the delivery of topical therapeutic agents used in the treatment of certain skin diseases, and also for delivery of medication used in the treatment of systemic diseases. Examples of percutaneous delivery include scopolamine, used for treatment of motion sickness, nitroglycerine for angina pectoris and estrogen for postmenopausal symptoms.

Several cell types constitute epidermis.

Melanocytes are cells derived from the neural crest. They migrate early during embryonic development and pass through the dermal mesenchyme to reside in the basal layer of the epidermis. There is approximately one melanocyte for every 10 basal keratinocytes. Unlike keratinocytes, melanocytes rarely divide and normally do not migrate upwards. Melanocytes have long, dendritic processes that reach the upper and lower layers of the epidermis. Through these dendrites melanocytes transfer melanosom to the keratinocytes.

Melanosomes are melanin-containing organelles that are synthesized by the melanocytes. Dark skin individuals produce more melanosomes and transfer more melanosomes to the keratinocytes. However interestingly, in different races the number of melanocytes is constant for a given cutaneous site. Melanocytes are the cells which give rise to the development of malignant melanoma.

Several cell types constitute the stratum bazale.

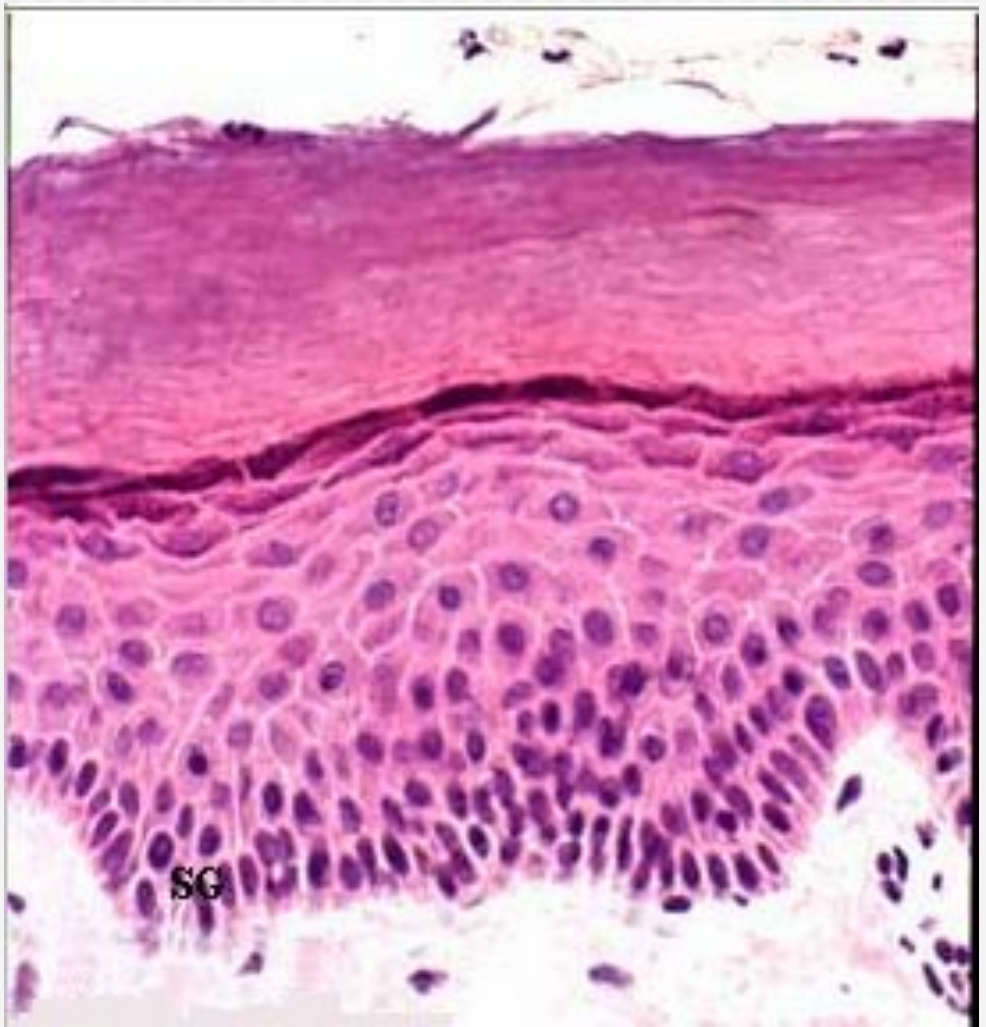
The function of melanin is to provide protection against the damaging effects of ultraviolet light. Individuals with light complexion and less melanin are prone to develop premature skin aging, precancerous skin lesions, and skin cancers of various types as a result of cumulative sun exposure.

Langerhans Cells These cells comprise 3-4% of the epidermal cells. They are derived from the bone marrow and serve as antigen-presenting cells to helper T Lymphocytes (CD4 positive cells). They participate in the development of contact hypersensitivity.

Merkel Cells are found in, or near, the basal cell layer of the epidermis. They surround hair follicles and are speculated to assist the touch receptors. Merkel cells resemble neurosecretory cells that produce polypeptide hormones, because similar to these cells, they have membrane bound secretory-like granules.

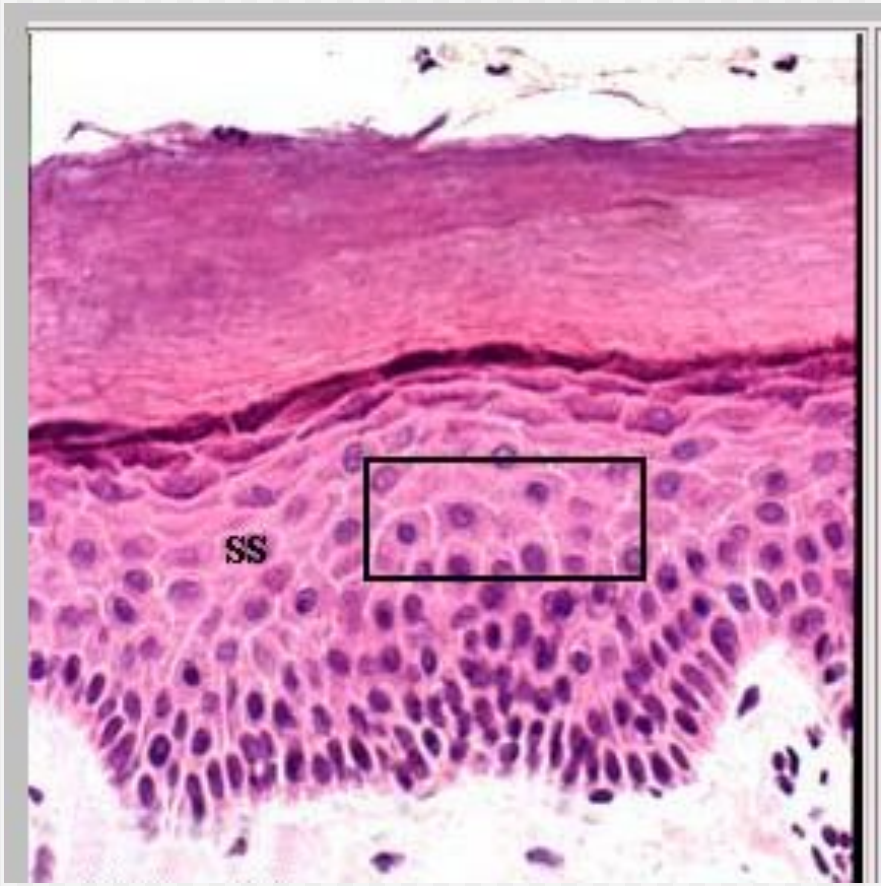
Stratum germinativum (bazale)

- The stratum germinatum (**SG**) provides the germinal cells necessary for the regeneration of the layers of the epidermis. These germinal cells are separated from the dermis by a thin layer of basement membrane. After a mitotic division a newly formed cell will undergo a progressive maturation called keratinization as its migrates to the surface.



Stratum spinosum

The cells that divide in the statum germinativum soon begin to accumulate many desmosomes on their outer surface which provide the characteristic “prickles” (seen on the close-up view) of the stratum spinosum (**SS**), which is often called the prickle-cell layer.

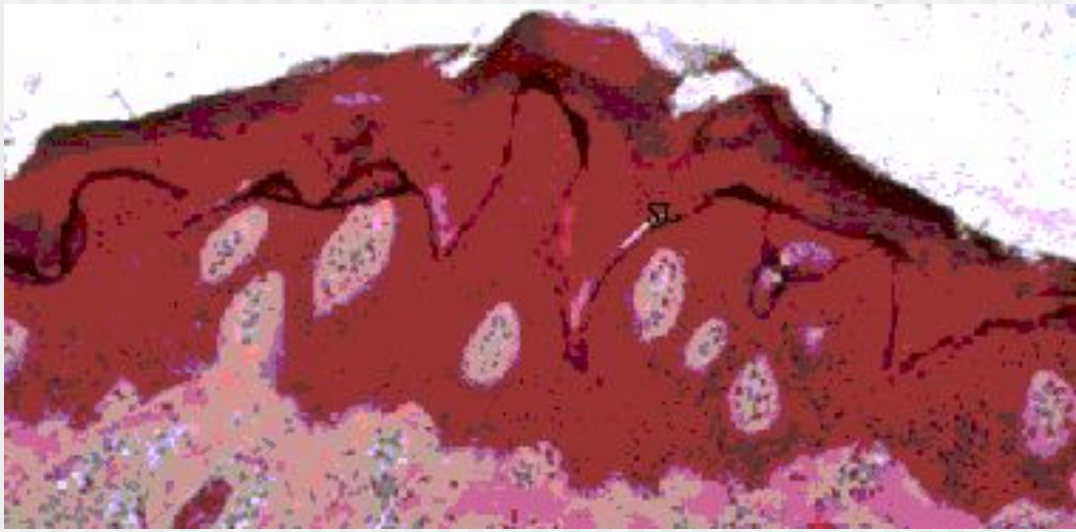


Stratum granulosum

- The progressive maturation of a keratinocyte is charcterized by the accumulation of keratin, called keratinization. The cells of the stratum granulosum (**SGR**) accumlate dense basophilic keratohyalin granules (seen on the close-up view). These granules contain lipids, which along with the desmosomal connections, help to form a waterproof barrier that functions to prevent fluid loss from the body.

Stratum Lucidum

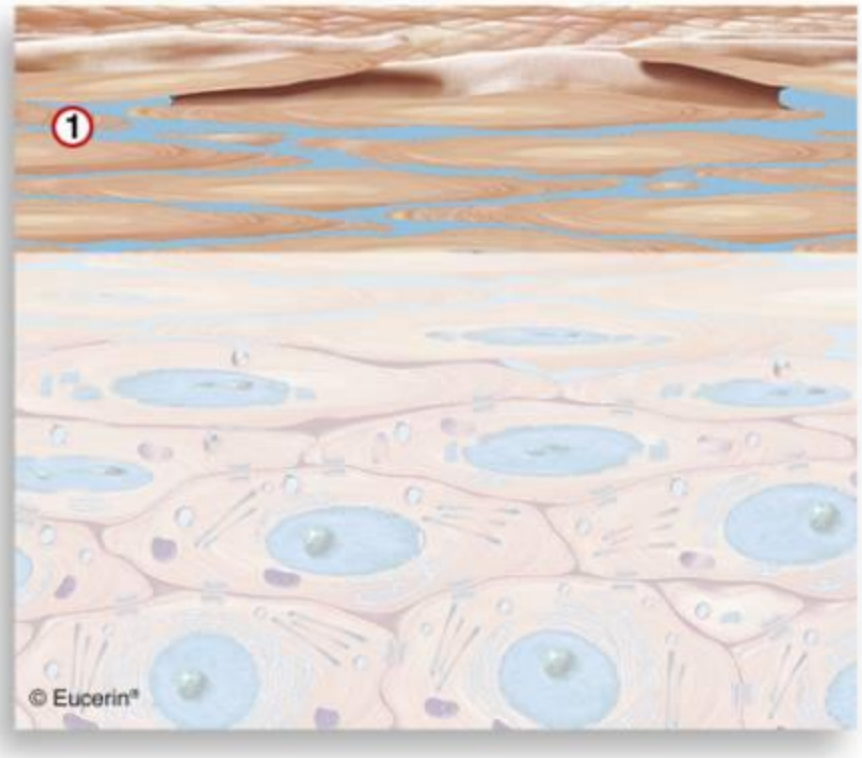
- Epidermis varies in thickness throughout the body depending mainly on frictional forces and is thickest on the palms of the hands and soles of the feet. The stratum lucidum is normally only well seen in thick epidermis and represents a transition from the stratum granulosum to the stratum corneum



The cells of the stratum lucidum contain eleidin.

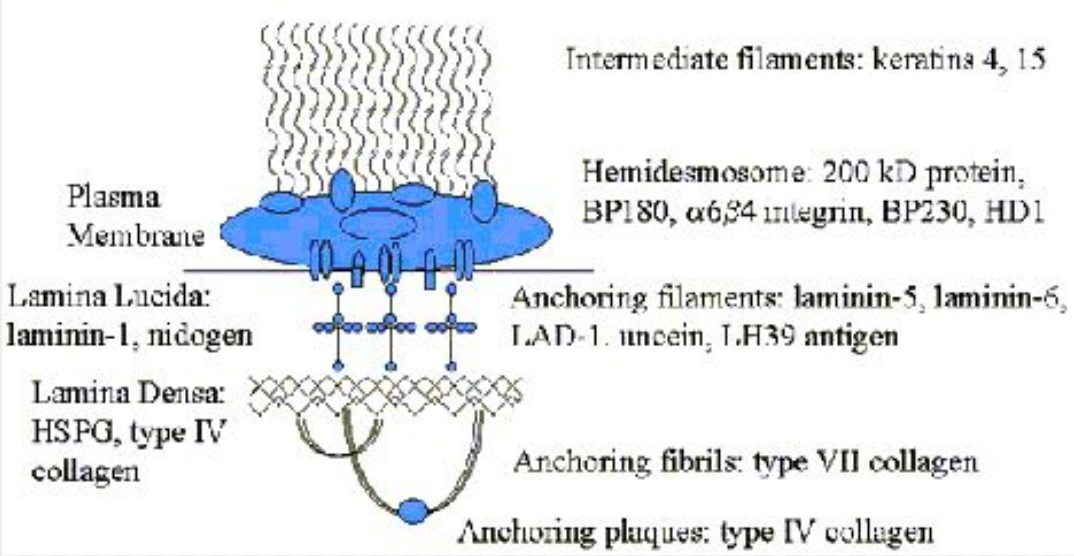
Stratum corneum

- As a cell accumulates keratinohyalin granules, it is thought that rupture of lysosomal membranes release lysosomal enzymes that eventually cause cell death. The dead and dying cells filled with mature keratin form the stratum corneum (**SC**). The deeper cells of the stratum corneum retain their desmosomal junctions, but as they are pushed to the surface by newly forming cells of the stratum germinativum (**SG**), the dead cells gradually break apart and are lost, a process called desquamation



The dermal-epidermal basement membrane

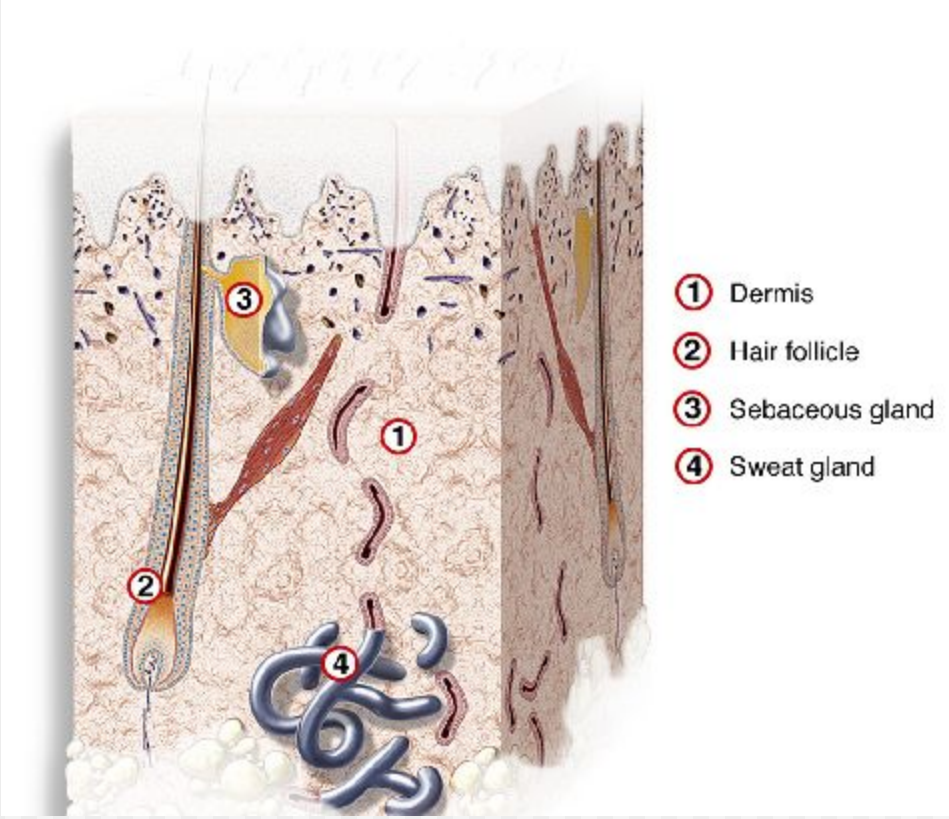
Between the epidermis and the dermis there is a basement membrane, composed of 3 ultramicroscopically distinct layers. The outermost layer is called lamina lucida.



It contains glycoproteins. The middle layer is called lamina dense. It contains type IV collagen. The innermost layer is called the sublamina dense zone. It contains the anchoring fibrils. The main function of the basement membrane is to anchor the epidermis into the dermis. Inherited or acquired defects in the basement membrane lead to the development of blistering diseases.

Dermis

- The dermis (**D**) assumes the important functions of thermoregulation and supports the vasular network to supply the avascular epidermis with nutrients. The dermis is typically subdivided into two zones, a papillary dermis) assumes the important functions of thermoregulation and supports the vasular network to supply the avascular epidermis with nutrients. The dermis is typically subdivided into two zones, a papillary dermis and a reticular layer. The dermis contains mostly fibroblasts which are responsible for secreting



Also present are immune cells that are involved in defense against foreign invaders passing through the epidermis.

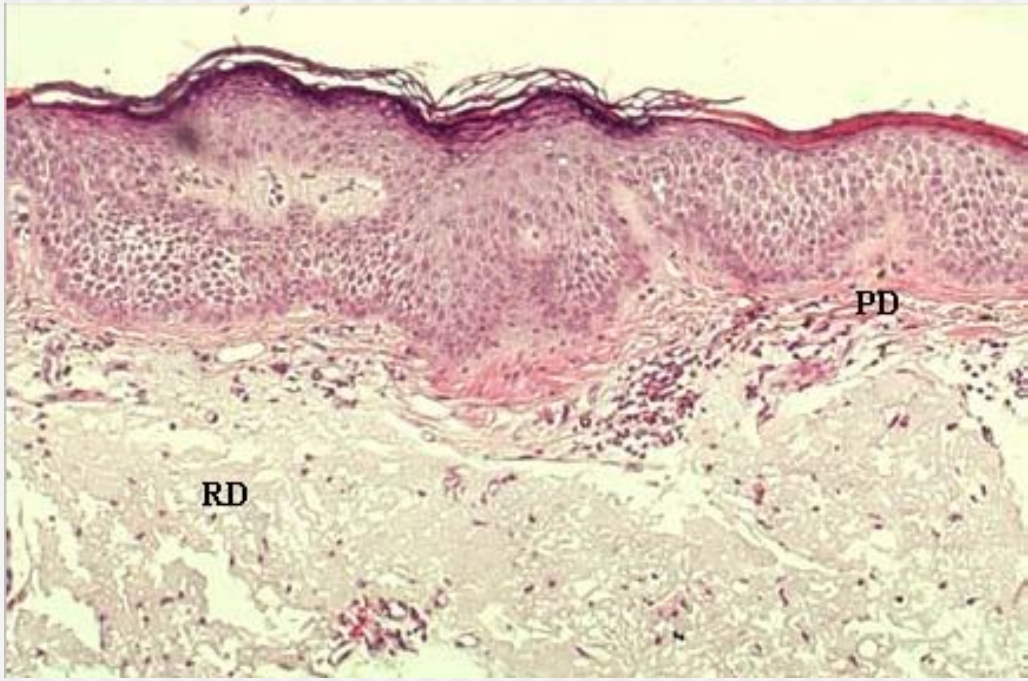
Layer	Consistence	Function
Papillary and reticular layers	1. Structural amorphous interstitial substance: 1. collagenous fibres 2. elastics fibres 3. argyrophile fibres 4. vessels 5. nerves an nerve endings	Provides turgor, dencity, nutrition, sencitivity of the skin.
	2. True homogeneous membrane 1. Lipoids 2. Mucopolysaccharides (mainly, hyaluronic and chondroitin – sulfuric acids) 3. Albuminis 4. Water	Protection due to immunoglobulins. Normalization of the water level.
	3. Cells structure 1. Fibroblasts 2. Histiocytes 3. Lymphocytes 4. Mast cells 5. Plasma cells 6. Melanophages 7. Epithelial appendages of the skin	Collagen Formation, and immunity.

Papillary dermis

- **The papillary dermis** (PD) contains vascular networks that have two important functions. The first being to support the avascular epidermis with vital nutrients and secondly to provide a network for thermoregulation. The vasculature is organized so that by increasing or decreasing blood flow, heat can either be conserved or dissipated. The vasculature interdigitates in areas called dermal papillae (DP). The papillary dermis also contains the free sensory nerve endings and structures called Meissner's corpuscles in highly sensitive areas.

Reticular dermis

- **The reticular layer** of the dermis (RD) consists of dense irregular connective tissue, which differs from the papillary layer (PD), which is made up of mainly loose connective tissue (note the difference in the number of cells). The reticular layer of the dermis is important in giving the skin it overall strength and elasticity, as well as housing other important epithelial derived structures such as glands and hair follicles.



Dermis

The dermis is the supporting layer of the epidermis. It consists of the fibrous components collagen and elastin, together with the ground substance. Lying within the dermis are the epidermal appendages, nerves and cutaneous vasculature. The cellular components of the dermis are fibroblasts, and occasionally inflammatory cells are present as well. The dermis is divided into two layers: the distal papillary dermis and proximal reticular dermis.

Dermis

1. **Fibrous Components and Ground Substance Collagens** comprise 98% of the dermal fibrous component. They provide the cutaneous structural stability. Elastic fibers comprise 2% of the dermal fibrous component. They provide cutaneous elasticity. The ground substance in which the dermal fibrous components are embedded, is a gel-like material that accounts for a large proportion of the dermal volume.

Dermis

2. **Blood Vessels** - The skin is richly vascularized. The cutaneous vasculature is required for dermal and epidermal nutrition as well as for thermoregulation. Cutaneous blood vessels do not enter the epidermis. This layer receives its modest nutritional requirement from the contiguous dermis. The skin receives an extensive blood supply from vessels within the subcutaneous fat. These give rise to two vascular plexuses: the deep vascular plexus and the superficial vascular plexus which are connected by intercommunicating vessels. Capillary loops extend into the papillary dermis and supply this part of the dermis as well as the epidermis.

Dermis

3**. Nerves** - Unmyelinated and myelinated sensory nerves are present in the dermis. Free nerve endings penetrate into the epidermis. Pain sensation is transduced by "fast" conducting fibers, while itchiness is transduced by "slow" conducting fibers. In addition, there are specialized sensory structures containing myelinated fibers which mediate the sensation of touch. They are called **Meissner's corpuscles**. The special structures that mediate pressure are called **Pacinian corpuscles**. Motor nerves innervate the blood vessels, sweat glands and the arrector pill muscle. The latter is a smooth muscle which arises in the connective tissue and inserts into the hair follicle. Its contraction produces the phenomenon called "goose flesh".

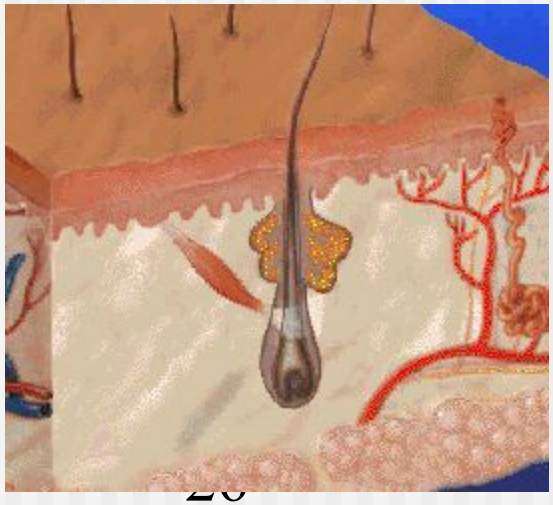
Dermis

4. **Epidermal appendages** during fetal development, specialized epithelial derived structures develop from the epidermis, towards the dermis. These structures are called epidermal appendages. Each performs a special function in the skin.

- Sebaceous Gland
- Sweat Glands
- Hair Follicle
- Nail

Sebaceous Gland

- **Sebaceous glands** are found everywhere on the human skin except on the palms, soles and dorsa of feet. They are part of the pilosebaceous unit and their secretion, sebum, flows through the sebaceous duct into the follicular canal. Sebaceous glands are larger and more dense on the face and scalp as compared to other areas of the body. Sebaceous gland secretion is holocrine in nature and it is a continuous process. Their growth is under endocrinologic
- control and the major stimulus affecting sebaceous gland growth and sebum section are androgens. In males testosterone and its metabolic products, like dihydrotestosterone, provide the major stimulus. In females sebaceous gland growth and sebum secretion is under the control of ovarian and adrenal androgens. Sebaceous gland growth is one of the earliest signs of puberty.



Sweat Glands

- There are two types of sweat glands: **eccrine** and **apocrine**. Eccrine glands are found in large numbers only in man and some primates. They are distributed over the entire skin surface. Their secretory portion is a coiled tubular structure located deep in the dermis. From this portion the ductal portion arises. The duct ascends straight through the dermis, assumes a spiral configuration in the epidermis (the acrosyringium), and opens onto the skin surface. Eccrine glands are innervated by sympathetic cholinergic fiber.
  The function of the eccrine glands is to respond to thermal stress by delivering hypotonic sweat to the skin surface where it evaporates, cooling the skin, and thereby reducing the core body temperature. Prolonged sweating may result in dehydration and electrolyte loss.

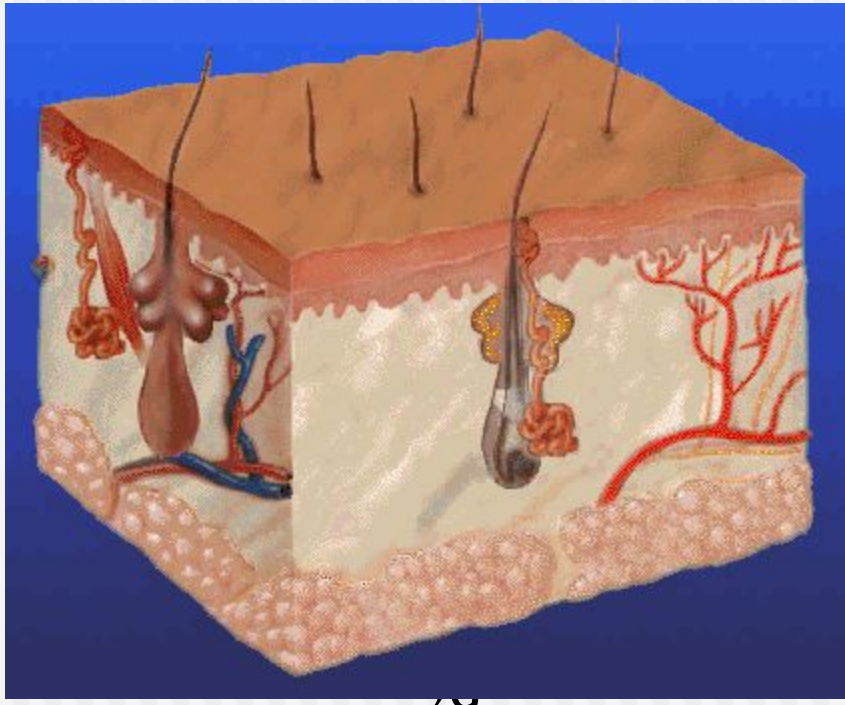
Sweat Glands

- Thermal sweating occurs over most of the body integument. Emotional stress can induce eccrine sweating, in selected areas like the palms, soles, axillae and forehead by a mechanism that is not well understood.
  Apocrine glands are found in many mammals. In man they are localized mainly to the axillary, areolar and genital regions; (modified apocrine glands are found in the breast and the external auditory canal). Like their eccrine counterparts, apocrine glands have a coiled secretory portion deep in the dermis. However, the duct leading from the apocrine gland, rather than opening directly onto the skin surface, it opens into the hair follicle above the entrance of the sebaceous duct. Myoepithelial cells, surrounding the gland, help to force the secretions outward.

Sweat Glands

Apocrine glands produce an odorless, oily fluid which acquires a scent only after it interacts with skin surface bacteria (diphtheroids). Apocrine glands continuously produce their secretions.

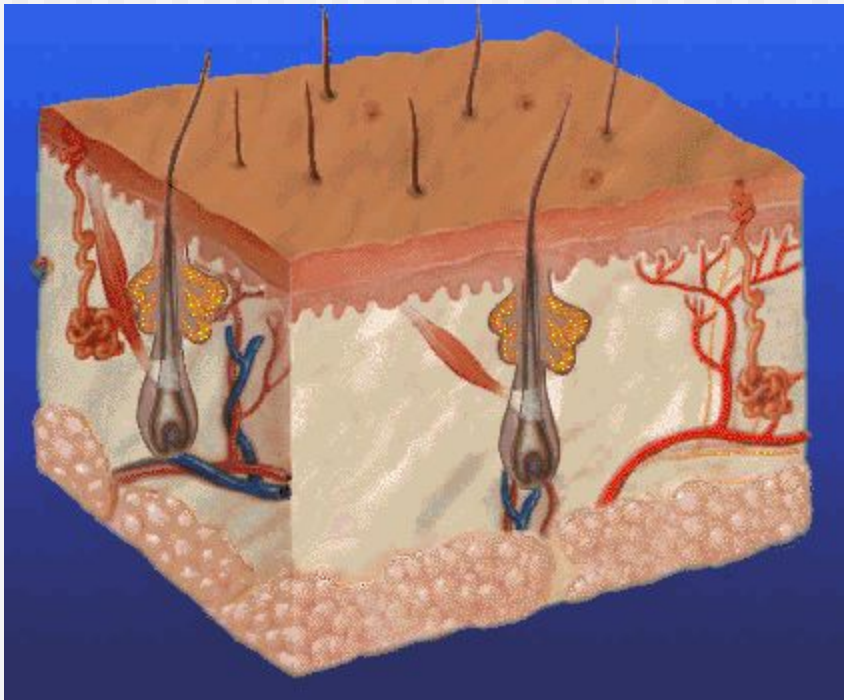
The gland is largely under hormonal influences but its duct is innervated by sympathetic adrenergic neurons. Apocrine glands are androgen responsive structures that become active at puberty. They contain large quantities of 5 alpha-reductase. Their function is presumed to be the production of sexual olfactory messages.



Hair Follicle

- **The hair follicle** consists of the hair surrounded by an epithelial sheath that is continuous with the epidermis. Except for its dermal papilla which contains connective tissue and blood vessels, the rest of the hair follicle is composed of epidermal cells.

- The bulb, at the lower end of the hair follicle, is the thickest part. It contains the proliferating pool of undifferentiated epidermal cells. Differentiation begins at the constriction above the bulb and continues halfway up the follicle where the cells begin to cornify. The hair is fully hardened as it emerges from the skin surface.



Hair Follicle

- Human hair grows in cycles. The longer the hair growth phase of an individual, the longer the hair length is. The growing stage is called anagen, followed by a transitional stage termed catagen, during which hair growth slows-down.
- This stage is followed by the resting phase, telogen. Once a hair has gone into telogen it is eventually shed and a new hair forms in the same follicle. Normally ~90% of scalp hairs are in anagen and ~10% in telogen. Hairs do not cycle together, therefore there is a daily loss of hairs throughout the entire scalp.
  During anagen the hair is firmly attached within its follicle; to dislodge it a force must be applied which is usually sufficient to fracture the hair in its non-keratinized zone, leaving a portion of the root behind in the follicle. Such a hair will have a ragged end where the fracture occurred. Anagen hairs if pulled intact will be encapsulated by a sheath around the end of the hair.

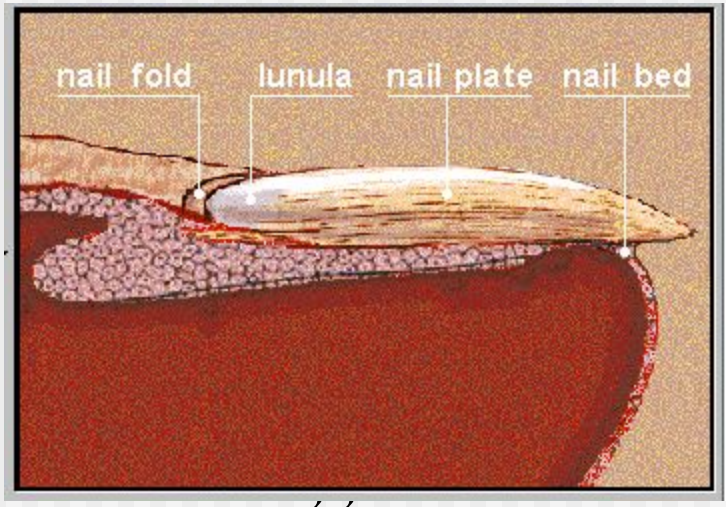
Hair Follicle

- Conversely, telogen hairs are easily dislodged and account for the normal loss, defluvium, that is encountered during combing, washing, etc. On examination telogen hairs have no encapsulating sheath but have a tiny "club" at the terminal end and therefore they are referred to as club hairs.
- Terminal hair growth in certain areas, such as the beard, chest, axillae and pubic triangle, is androgen-dependent. There are racial differences in hair density and distribution as well as structural variations in the hair shaft and follicles, accounting for hair texture.

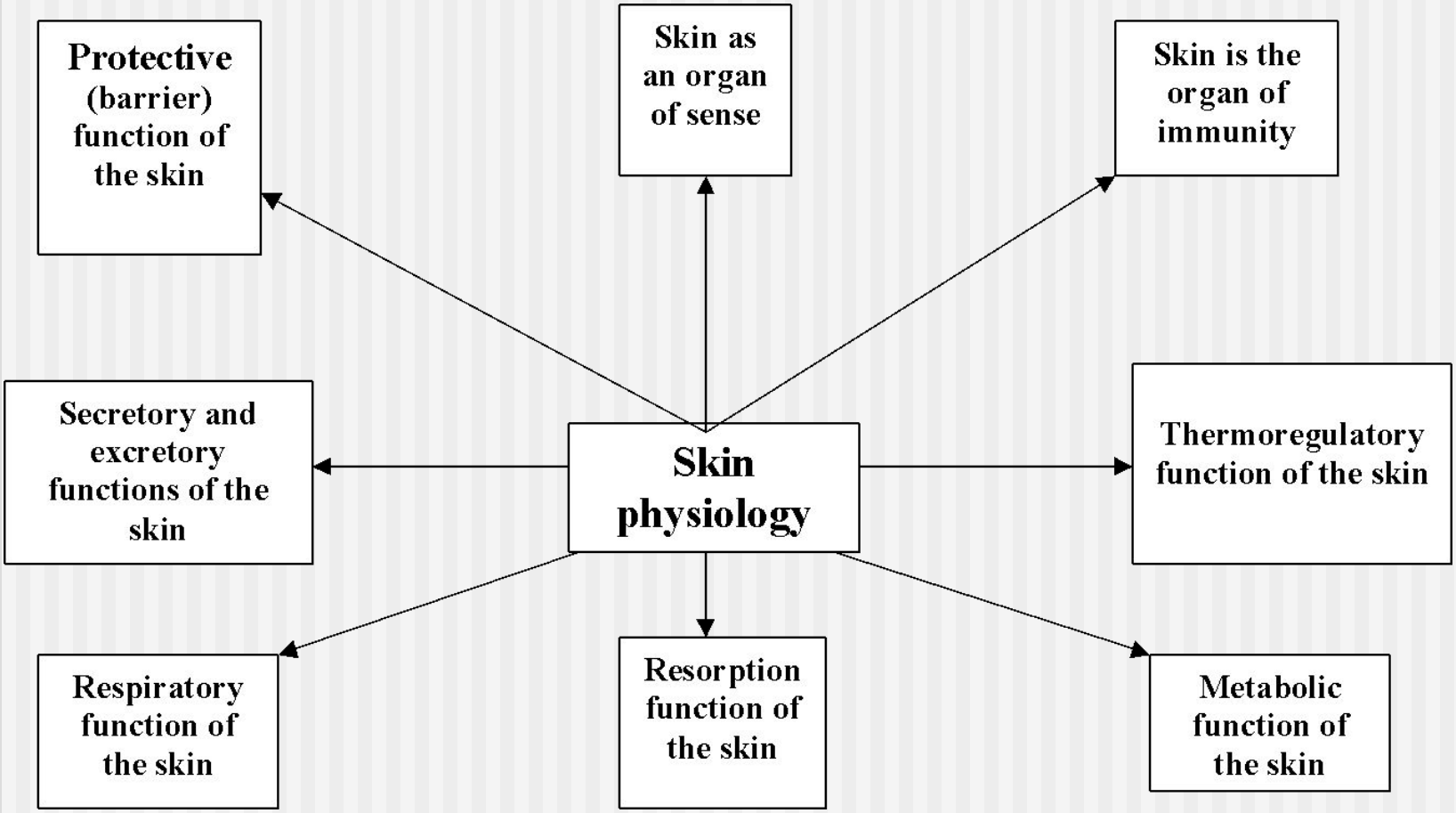
Nail

Nails consist of the nail plate and the supporting tissues which surround it. The nail plate is made of horny material which is unlike the stratum corneum in that it does not undergo desquamation. It extends in length indefinitely until it is cut or worn away by use.
The nail plate is set in grooves that are located on the dorsal surface of the distal part of the digit. These grooves are referred to as the lateral and proximal nail grooves.

The grooves are covered by the lateral and proximal nail folds. The nail plate is a translucent and colorless structure. Most digits display a white semicircular lunula at the proximal end of the nail plate. The lunula ends distally in the nail matrix. The matrix is the region which synthesizes the nail plate. It extends approximately 5 mm underneath the proximal nail fold.



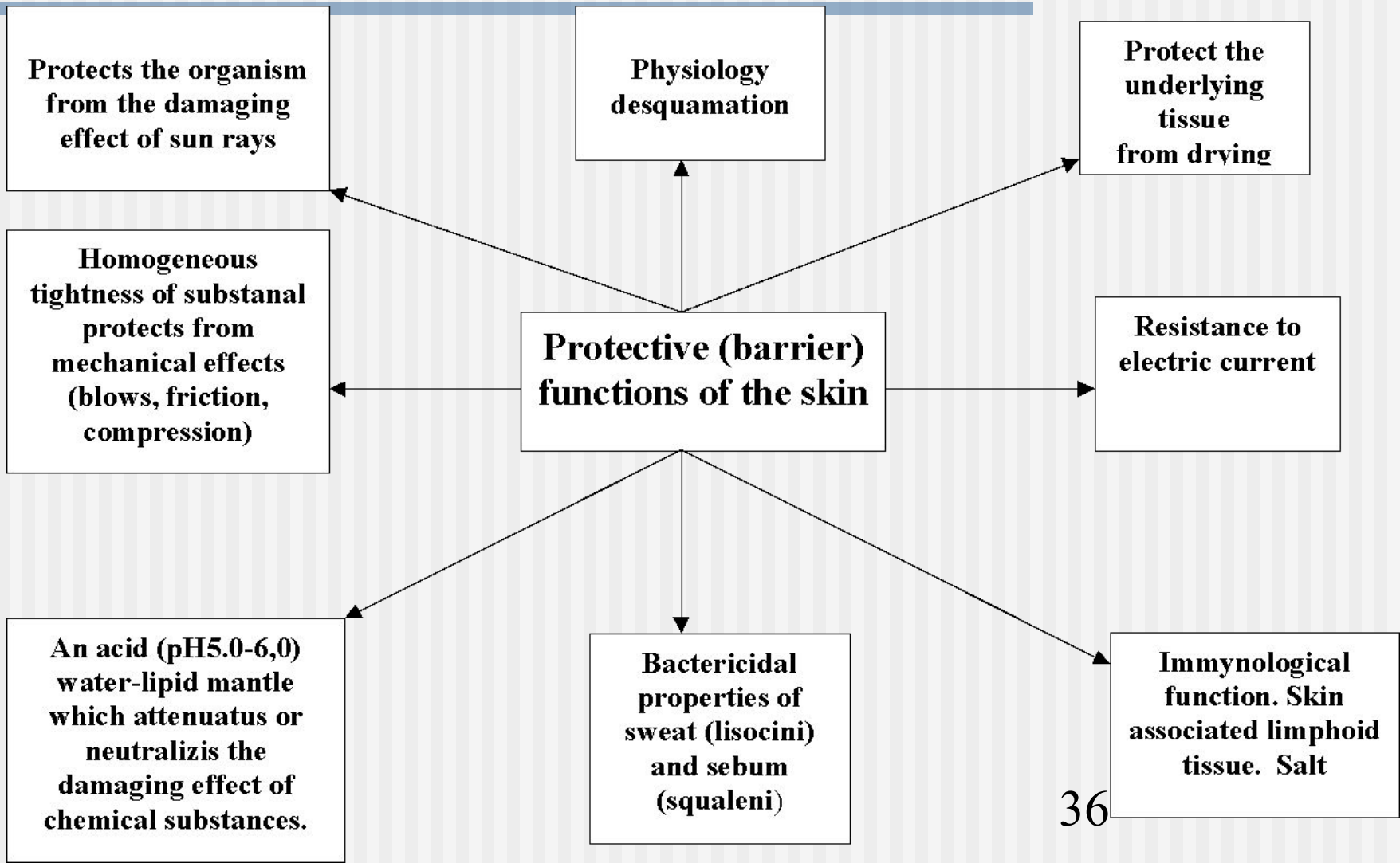
Skin Physiology



Skin Function

A. Sensation (largest sensory organ in the body)
B. Protection
    1. Prevents dehydration
    2. Prevents infection
    3. Physical barrier to injury
    4. Protects against ultraviolet light injury (Melanin)
C. Thermoregulation
    1. Insulation (hair and adipose tissue)
    2. Heat dissipation
        a. Sweat evaporation
        b. Increased blood flow
D. Metabolic
    1. Energy storage of Triglycerides in adipose tissue
    2. Vitamin D synthesis

Protective function



Epidermis Cell Layers (cells mature from inner to outer)

A. Stratum Corneum (Cornified Layer)
    1. Outermost layer of epidermis
    2. Composed mostly of keratin (fibrous protein)
    3. Cells desquamated (27 days after production)
B. Stratum Lucidum (present only in very thick skin)
C. Stratum Granulosum (Granular Layer)
    1. Darker layer with intracellular granules
    2. Produces keratin
D. Stratum Spinosum (Prickle Cell Layer)
    1. Composed of keratinocytes
    2. Cells produced by basal layer and growing
    3. Keratin production starts
E. Stratum Germinativum (Stratum Basale, Basal Cell Layer)
    1. Innermost layer of epidermis
    2. Cells are produced here in the germinal layer
    3. Forms the prickle cells in the layer above

Sensory Apparatus of the Skin

- The skin is innervated with around one million afferent nerve fibers. Most terminate in the face and extremities; relatively few supply the back. The cutaneous nerves contain axons with cell bodies in the dorsal root ganglia. Their diameters range from 0.2-20 μm. The main nerve trunks entering the subdermal fatty tissue each divide into smaller bundles. Groups of myelinated fibers fan out in a horizontal plane to form a branching network from which fibers ascend, usually accompanying blood vessels, to form a mesh of interlacing nerves in the superficial dermis. Throughout their course, the axons are enveloped in Schwann cells and as they run peripherally, an increasing number lack myelin sheaths. Most end in the dermis; some penetrate the basement membrane, but do not travel far into the epidermis.

Sensory Apparatus of the Skin

- Sensory endings are of two main kinds: corpuscular, which embrace non-nervous elements, and 'free', which do not. Corpuscular endings can, in turn, be subdivided into encapsulated receptors, of which a range occurs in the dermis, and non-encapsulated, exemplified by **Merkel's 'touch spot'** which is epidermal.
- Each **Merkel's touch spot** is composed of a battery of Merkel cells borne on branches of a myelinated axon. A Merkel cell has a lobulated nucleus and characteristic granules; it is embedded in the basal layer of epidermal cells, with which it has desmosomal connections; it contains intermediate filaments composed of low molecular weight keratin rather than neurofilament protein.

Sensory Apparatus of the Skin

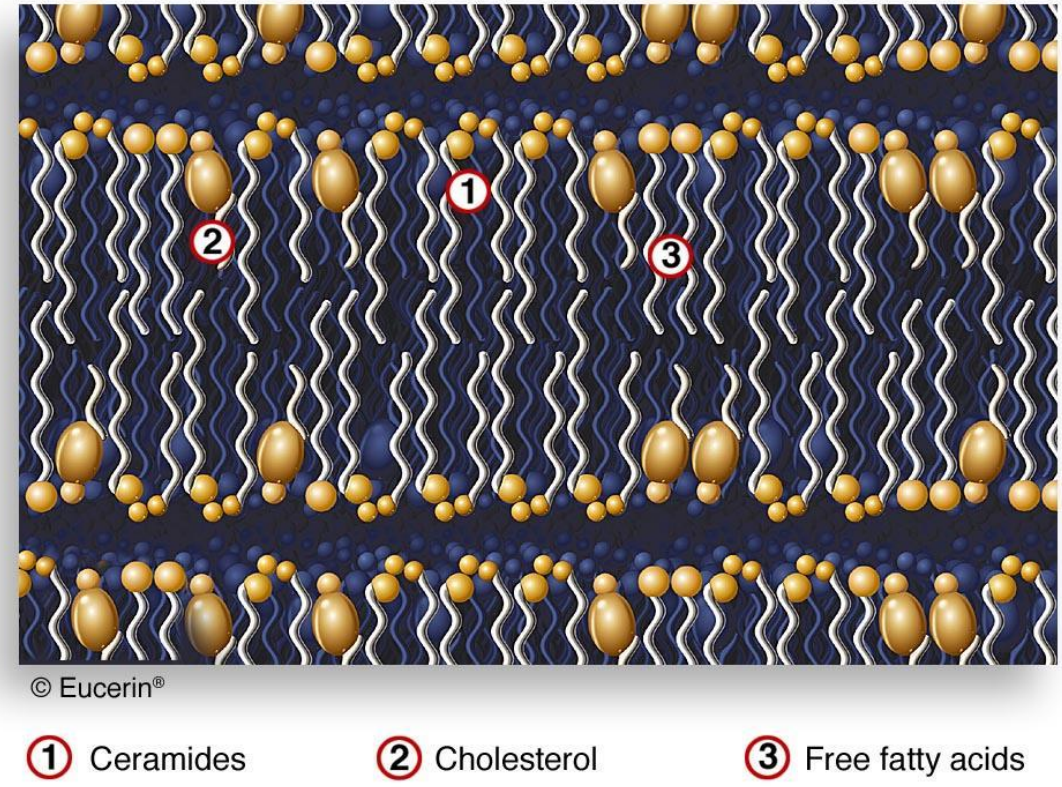
- **The Pacinian corpuscle** is one of the encapsulated receptors. It is an ovoid structure about 1mm in length, which is lamellated in cross-section like an onion, and is innervated by a myelinated sensory axon which loses its sheath as it traverses the core. The Golgi-Mazzoni corpuscle found in the subcutaneous tissue of the human finger is similarly laminate but of much simpler organization. These last two lamellated end organs are movement and vibration detectors.
- **The Krause end bulb** is an encapsulated swelling on myelinated fibers situated in the superficial layers of the dermis. Meissner corpuscles are characteristics of the papillary ridges of glabrous (hairless skin) skin; they are touch receptors; they have a thick lamellated capsule, 20-40 μm in diameter and up to 150 μm long.

Sensory Apparatus of the Skin

- **Ruffini endings** in the human digits have several expanded endings branching from a single myelinated afferent fibre; the endings are directly related to collagen fibrils; they are stretch receptors.
- **'Free nerve endings'**, which appear to be derived from non-myelinated fibers occur in the superficial dermis and in the overlying epidermis; they are receptors for pain, touch, pressure and temperature. Hair follicles have fine nerve filaments running parallel to and encircling the follicles; each group of axons is surrounded by Schwann cells; they mediate touch sensation.

Composition of the lipid membrane

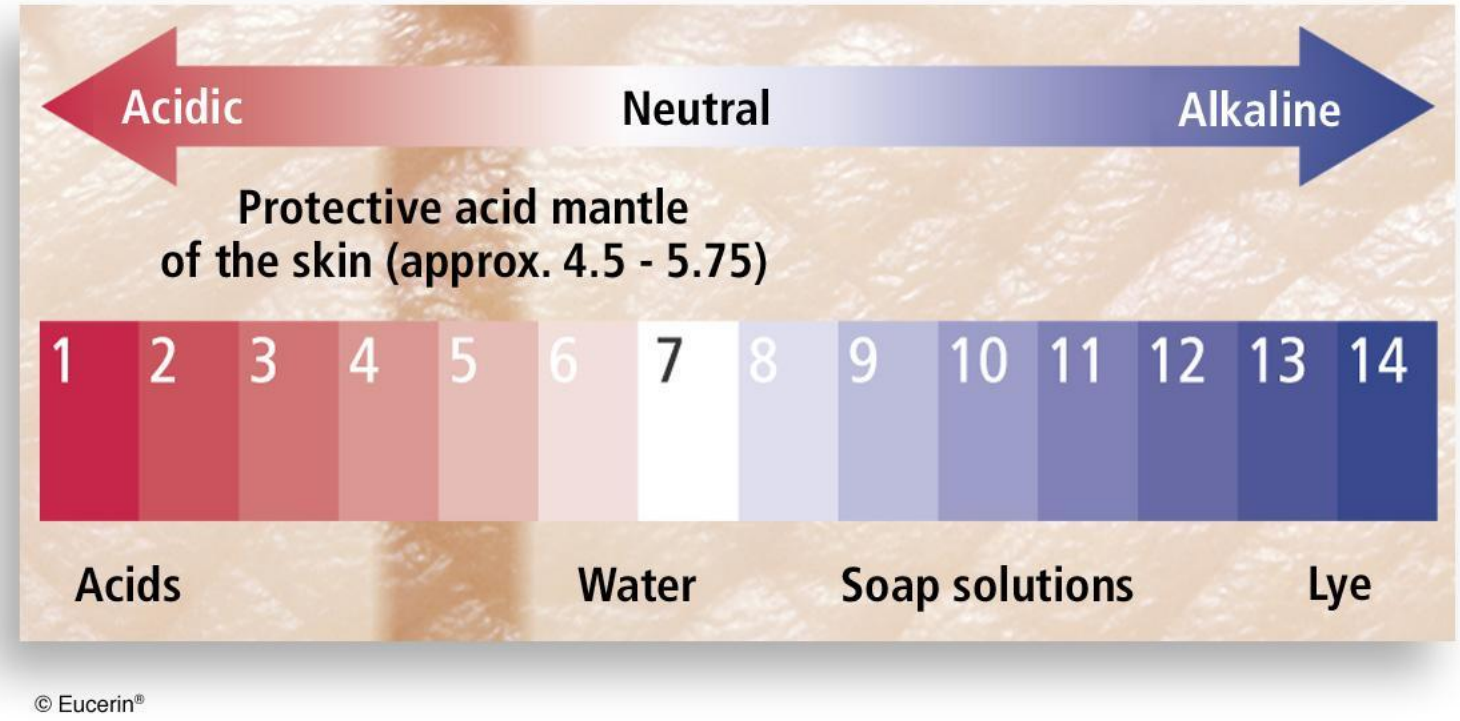
The most important barrier lipids are **ceramides, cholesterol and free fatty acids**. Quantitative and qualitative changes in the composition of these lipids can lead to a disturbed barrier function.



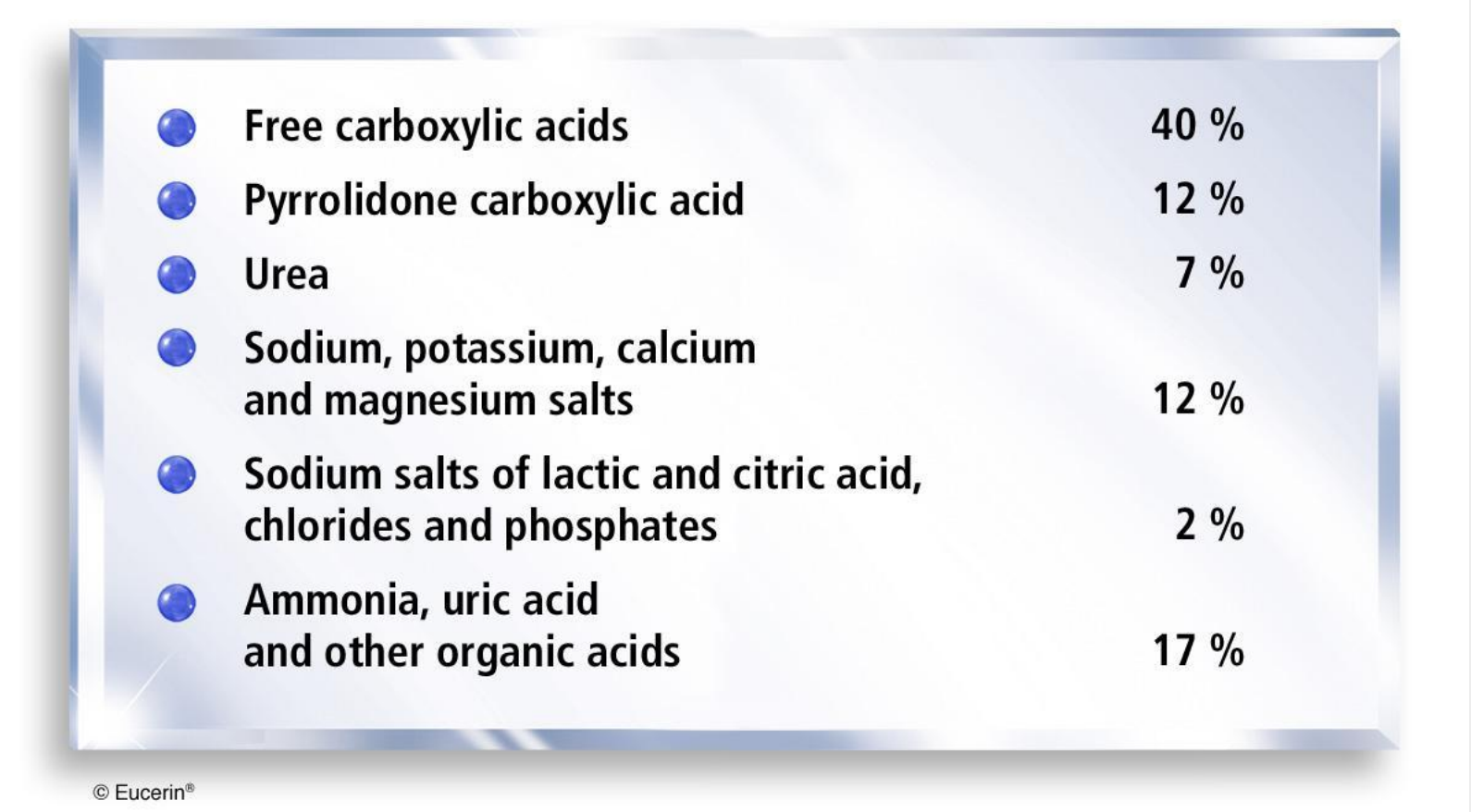
Other functions of the skin

- The skin is structured to prevent loss of essential body fluids, and to protect the body against the entry of toxic environmental chemicals. In the absence of a stratum corneum we would all lose significant amounts of water to the environment, and rapidly become dehydrated. The stratum corneum with its overlapping cells and intercellular lipid, makes diffusion of water into the environment very difficult.
  The skin is also part of the innate immunity (natural resistance) of the body against invasion by micro-organisms. The dryness and constant desquamation of the skin, the normal flora of the skin, the fatty acids of sebum and lactic acid of sweat, all represent natural defense mechanisms against invasion by micro-organisms. Langerhans cells present in the epidermis have an antigen-presenting capacity and might play an important role in delayed hypersensitivity reactions.

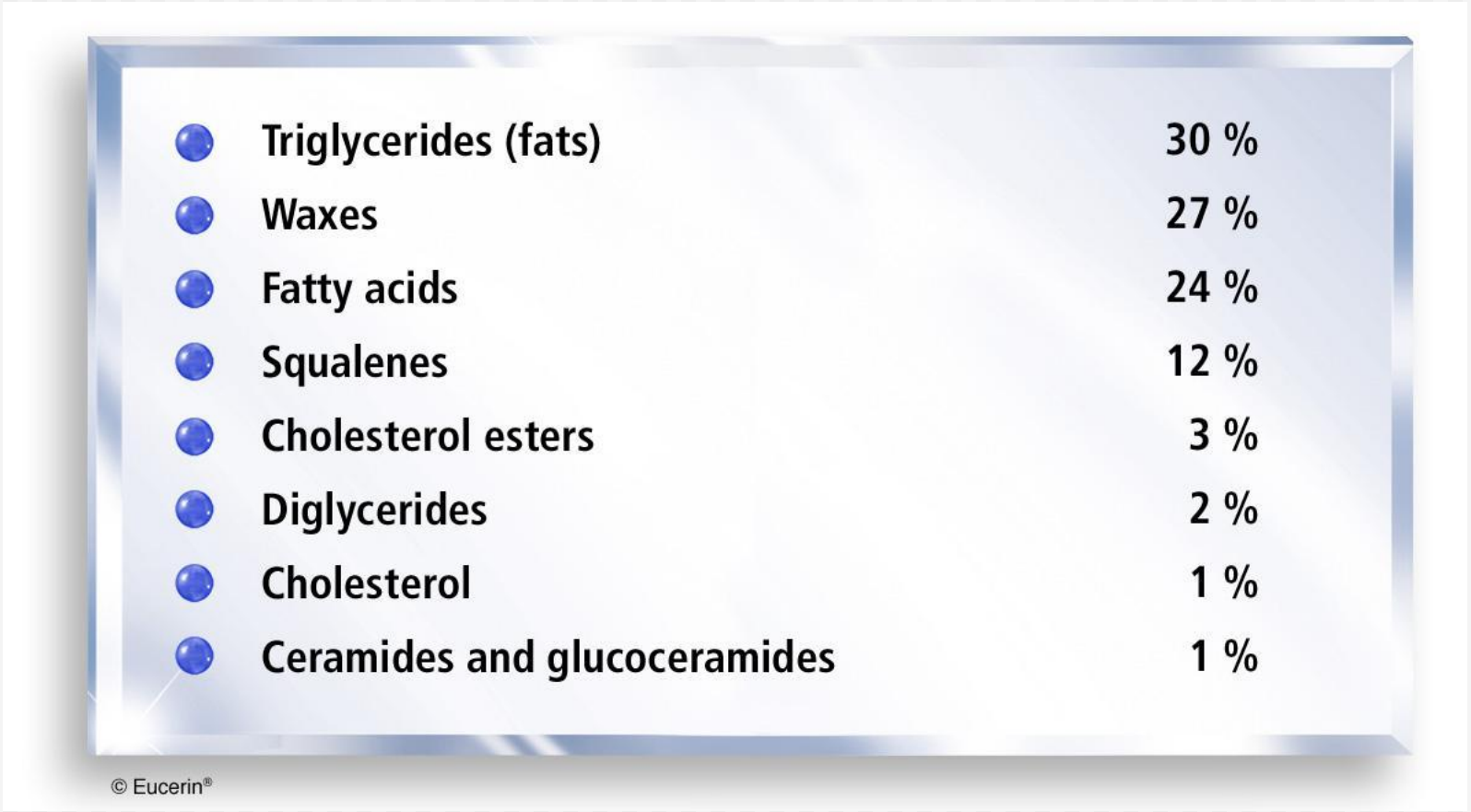
Protective functions of the skin



Natural Moisturising Factors

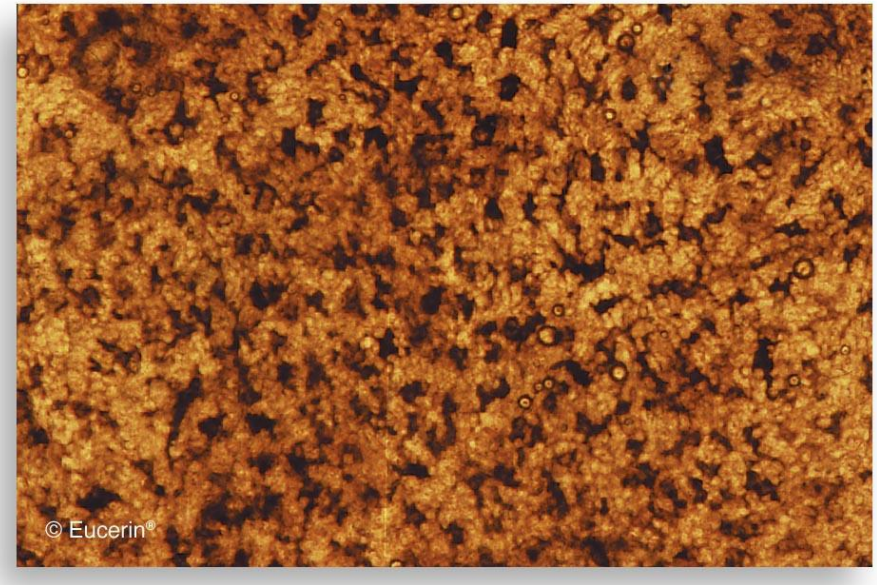


Skin surface lipids

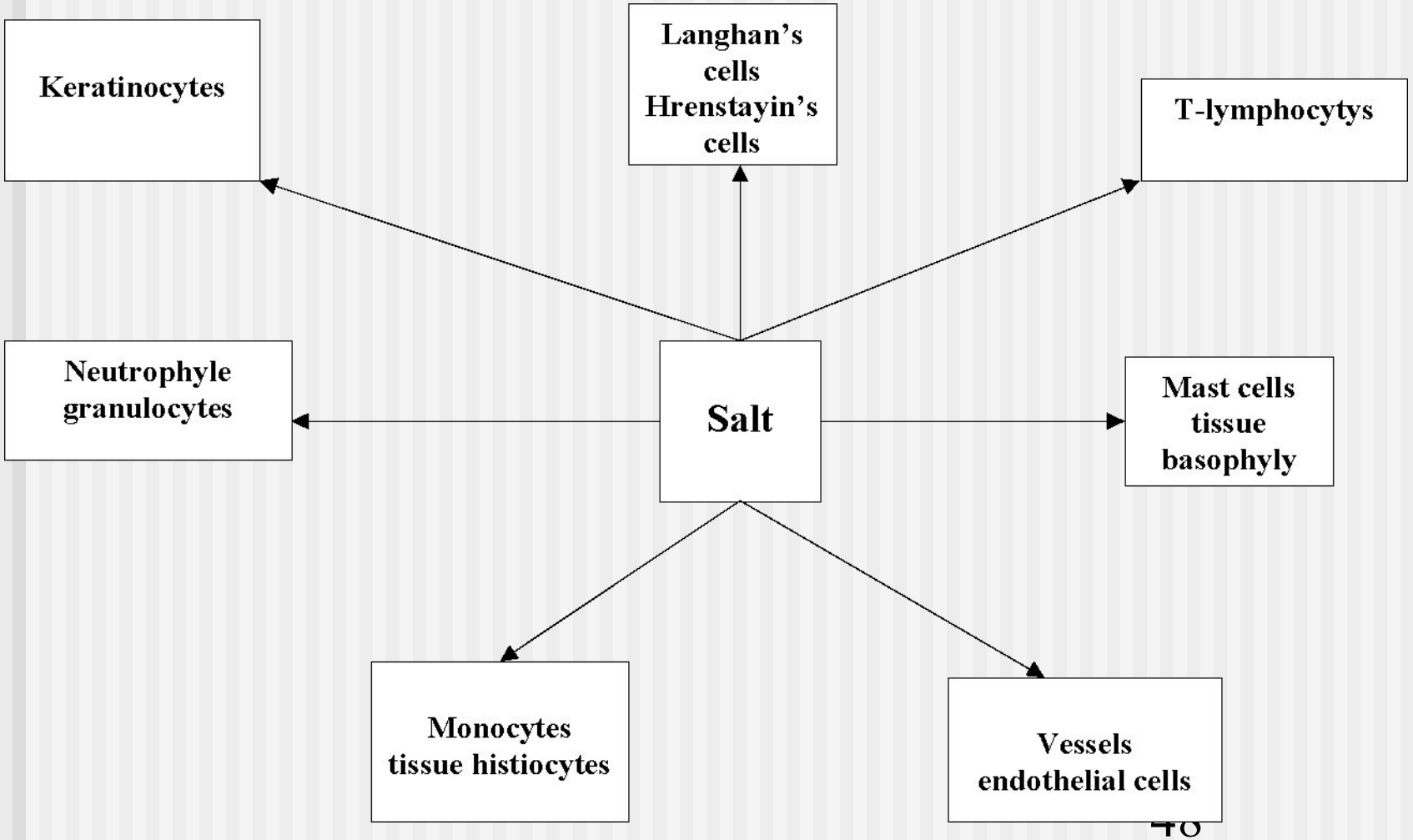


The skin‘s immune system

They also play a role in immunosurveillance against viral infections. Langerhans cells interact with neighboring keratinocytes, which secrete a number of immunoregulating cytokines, and epidermotropic T-cells forming the skin immune system: SALT (skin associated lymphoid tissue).



SALT


Keratinocytes
Langhan's cells Hrenstayin's cells
T-lymphocytys
Neutrophyle granulocytes
Salt
Mast cells tissue basophyly
Monocytes tissue histiocytes
Vessels endothelial cells

Other functions of the skin

- **Melanin pigment** of the skin protects the nuclear structures against damage from ultraviolet radiation.

  The skin is also a huge sensory receptor for heat, cold, pain, touch, and tickle. Parts of the skin are considered as erogenous zones. The skin has great psychological importance at all ages. It is an organ of emotional expression and a site for the discharge of anxiety. Caressing favors emotional development, learning and growth of newborn infants.

Other functions of the skin

- The skin is a vital part of the body's temperature regulation system, protecting us against hypothermia and hyperthermia, both of them may be fatal (specialized vascular structures of the dermis/insulation by fat in subcutaneous tissue/evaporation of sweat).
  The skin plays an important role in calcium homeostasis by contributing to the body's supply of vitamin D. Vitamin D3 (cholecalciferol) is produced in the skin by the action of ultraviolet light on dehydrocholesterol. It is then hydroxylated in the liver and kidneys (needs parathyroid hormone to activate alpha-hydroxylase) to 1,25 dihydroxycholecalciferol, the active form of vitamin D. This anti-rachitic vitamin acts on the intestine increasing calcium absorption (through stimulation of synthesis of calcium-binding proteins in the mucosal cells of the intestine), as well as on the kidneys promoting calcium reabsorption.

Other functions of the skin

- **Fingerprints,** the characteristic elevated ridge patterns on the finger tips of humans, are unique to each individual. The fingers and toes, the palms of the hands and soles of the feet, are covered with a system of ridges which form certain patterns. The term dermatoglyphics is applied to both the configurations of the ridges, and also to the study of fingerprints. The medicolegal importance of the ridge patterns of fingerprints, characteristic dermatoglyphic abnormalities frequently accompany many chromosomal aberrations.