

THE STRUCTURE AND FUNCTION OF THE SKIN

The skin

- largest organ of the body
- protects us from microbes and the elements
- helps regulate body temperature
- and permits the sensations of touch, heat, and cold

Skin of an adult person

- surface 1,5 -2 m²
- weight 18-20 kg (15-19 % of total weight)
- epidermis and dermis thickness - 2 mm (0,5 - 3,5 kg)
- subcutis thickness - 8-25 mm

Layers of the skin

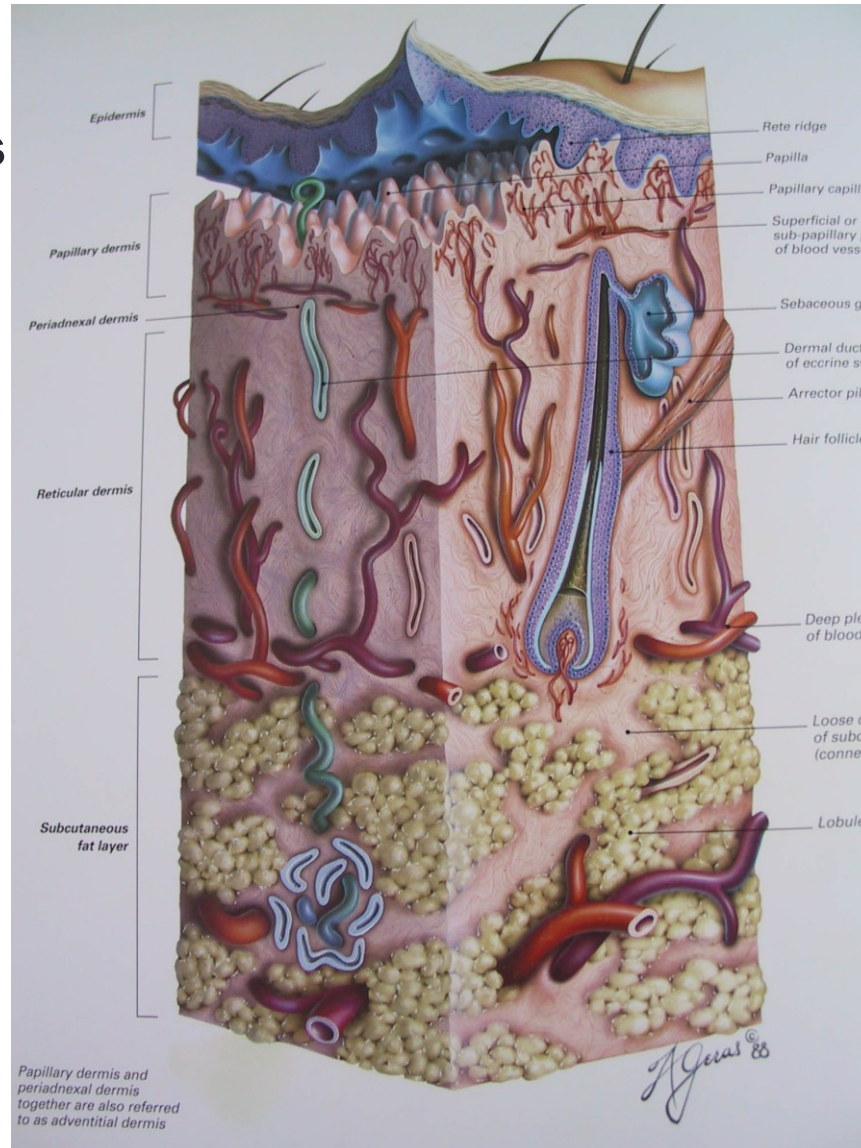
- **Epidermis** - the outermost layer of skin, provides a waterproof barrier and creates our skin tone
- **Dermis** - beneath the epidermis, contains connective tissue, muscles, sensory neurons, blood vessels, hair follicles, hairs, and sweat glands
- **Subcutaneous tissue (hypodermis)** - made of fat and connective tissue.

Layers of the skin

Epidermis

Dermis

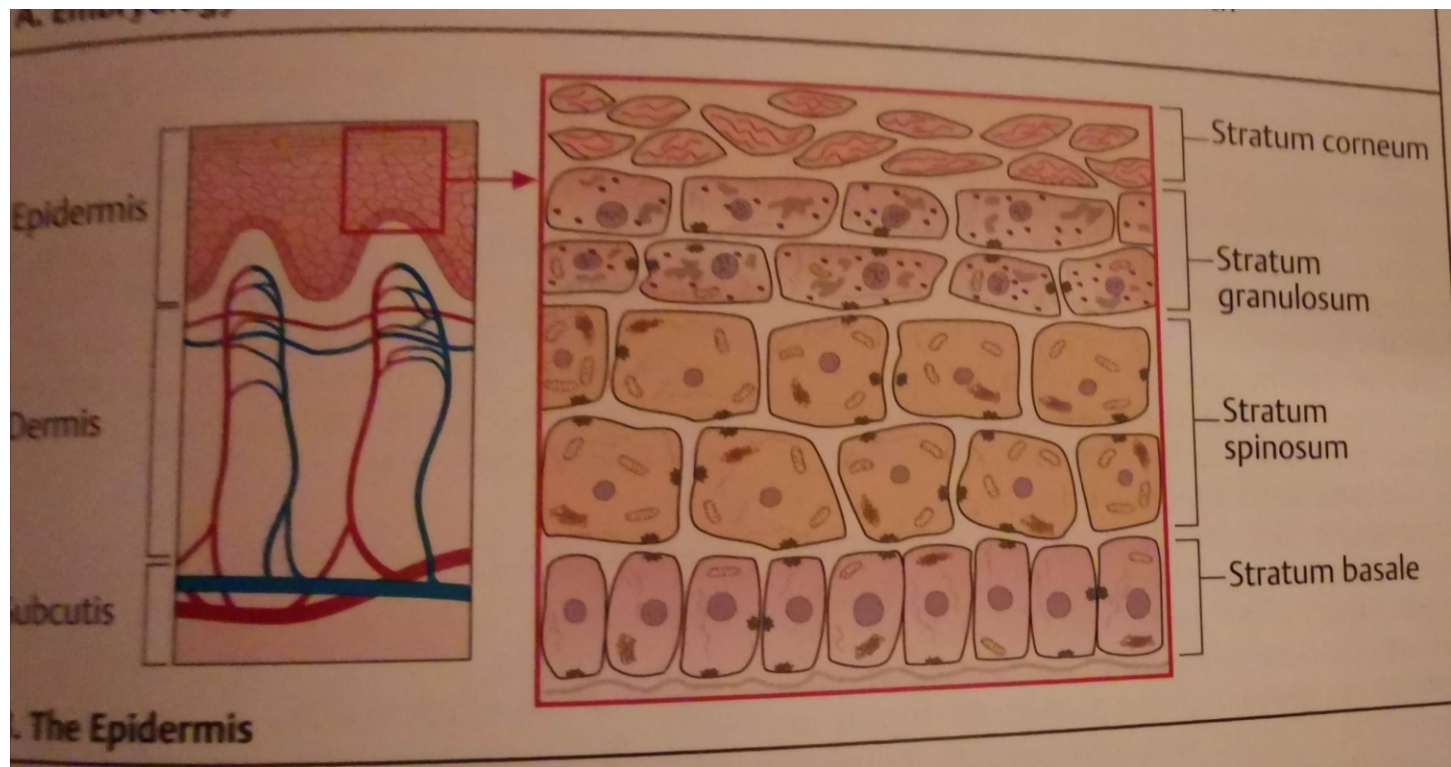
Subcutaneous fat



1. Epidermis

- the thinnest part of the skin - thickness 0,3 – 1,5 mm
- the outermost layer of skin
- formed by cells:
 - keratinocytes - arranged into 5 layers
 - melanocytes
 - Langerhans cells
 - Merckels cells

1. Epidermis

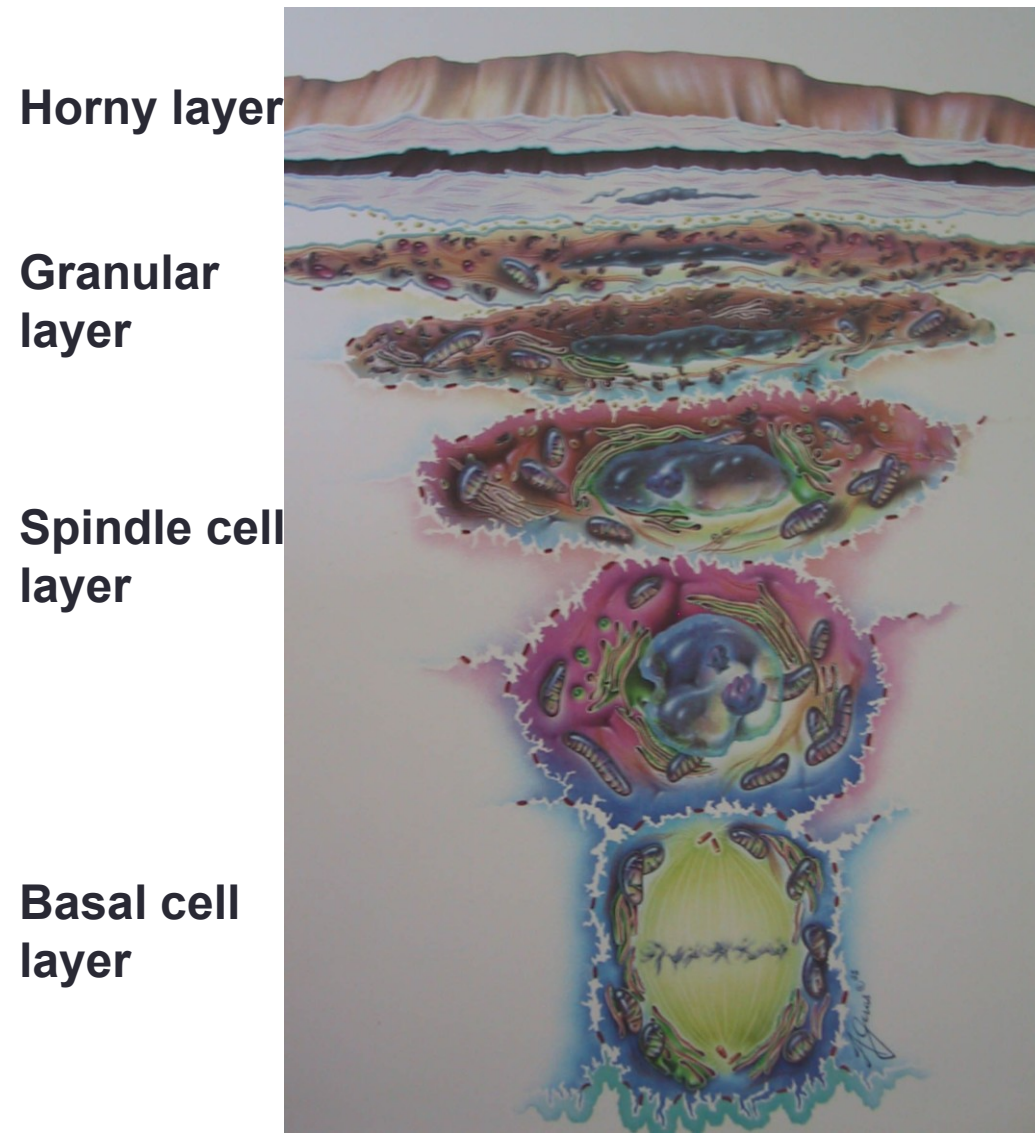


Layers of epidermis and keratinocytes

- **Stratum basale**
 - the deepest part of the epidermis, proliferation of keratinocytes occurs there, the keratinocytes are connected by molecules called desmosomes to each other and to the basal membrane (layer between epidermis and dermis) are connected by hemidesmosomes
- **Stratum spinosum**
 - above str. basale, layer where process of differentiation starts (change in morphology of keratinocyte and production of keratin)
- **Stratum granulosum**
 - an area where the keratinization process is completed and keratohyalin granules become visible (precursors for keratin)
- **Stratum lucidum**
 - amorphous band between str. granulosum and str. corneum (visible by microscope only on palms and soles of feet)
- **Stratum corneum**
 - consists of corneocytes (remnants of keratinocytes) made up of keratin and cell walls without nuclei

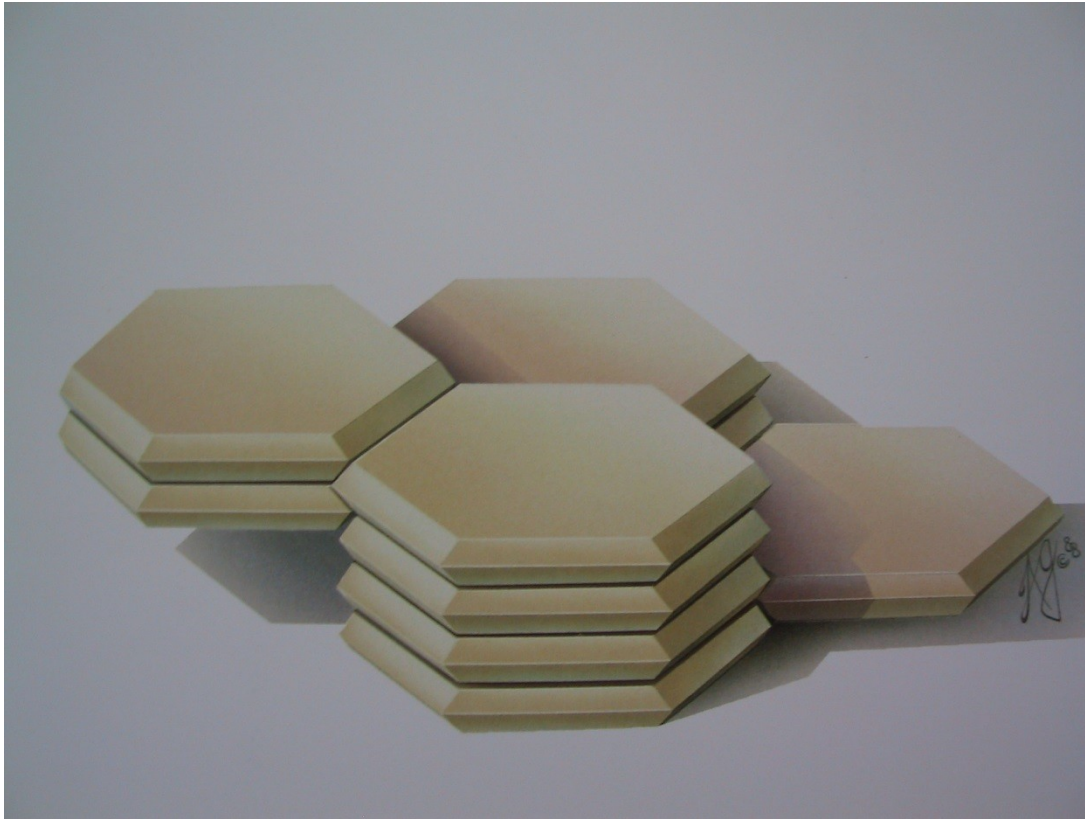
Keratinocytes of stratum basale and lower part of stratum spinosum have ability to divide – this part is called **stratum germinativum Malpighi**

Keratinization



- the epidermis is a self-renewing structure
- keratinocytes are formed by mitosis in the stratum basale
- as they move up through the stratum spinosum and stratum granulosum, they differentiate to form a rigid internal structure of keratin, microfilaments and microtubules (keratinization)
- the outer layer of the epidermis, stratum corneum, is composed of layers of flattened dead cells (corneocytes) that have lost their nucleus. T
- corneocytes are shed from the skin in process called desquamation
- this process takes approximately 28 days, the change from a basal layer keratinocytes to a corneocyte takes 14 days and then the loss of this cell remnant as scale occurs after another 14 days

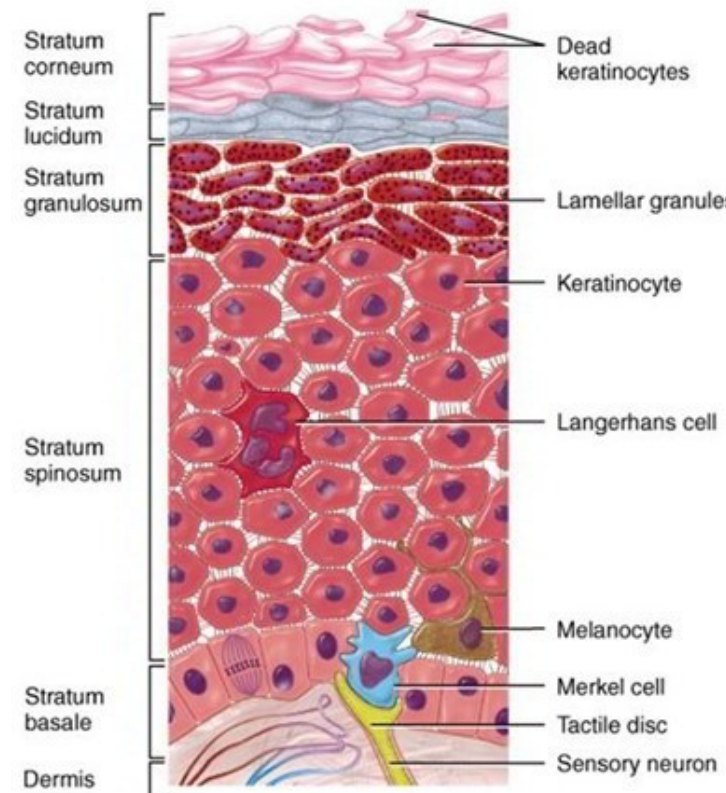
Horny layer - epidermal barrier



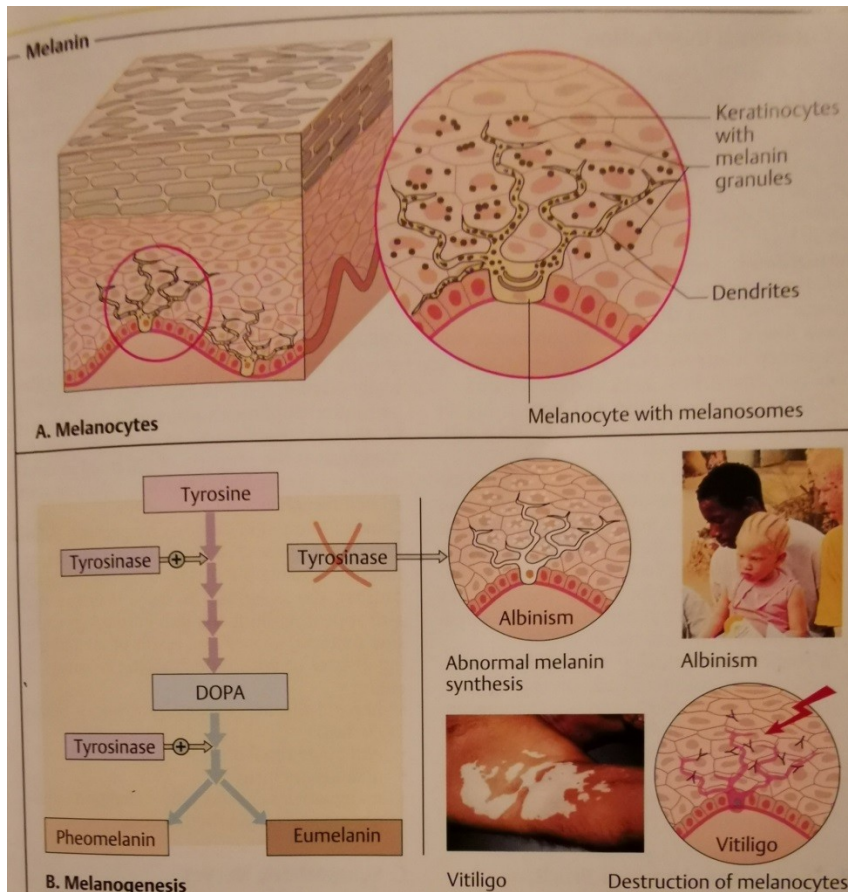
- surface of epidermis is called horny layer (stratum corneum) or epidermal barrier
- stratum corneum can be compared to a brick wall
- the keratinocytes are connected together due to epidermal lipids and adhesion molecules
- the lipids stabilize the epidermis and help to seal the barrier but also allow the passage of substances through the epidermis in both directions

Other cells in the normal epidermis

- **Melanocytes** – synthesize melanin (main photoprotective factor)
- **Langerhans cells** – antigen-processing cells of the skin
- **Merkel cells** – neuroendocrine cells that function as mechanoreceptors

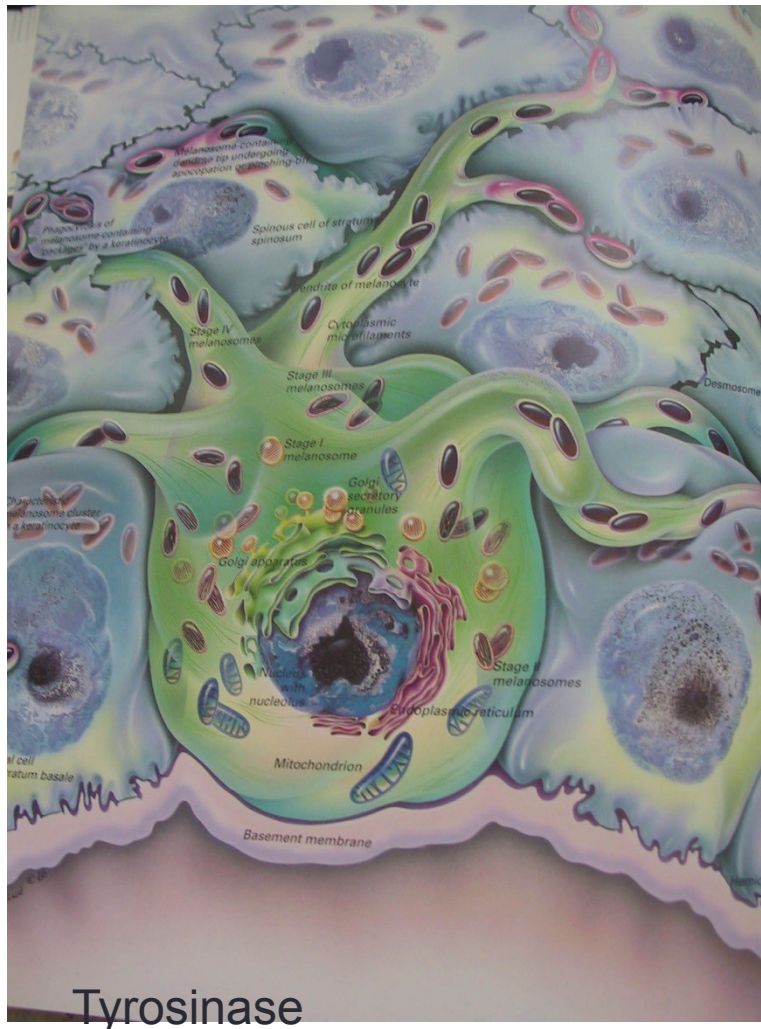


Melanocytes



- clear cells located in the stratum basale
- are derived from the neural crest and migrate into epidermis
- main function of melanin is to absorb ultraviolet (UV) radiation to protect us from its harmful effects

Epidermal melanin unit



- synthesis of melanin is complex process starting with tyrosine, the most important enzyme is tyrosinase
An important intermediate is DOPA (a precursor of dopamine)

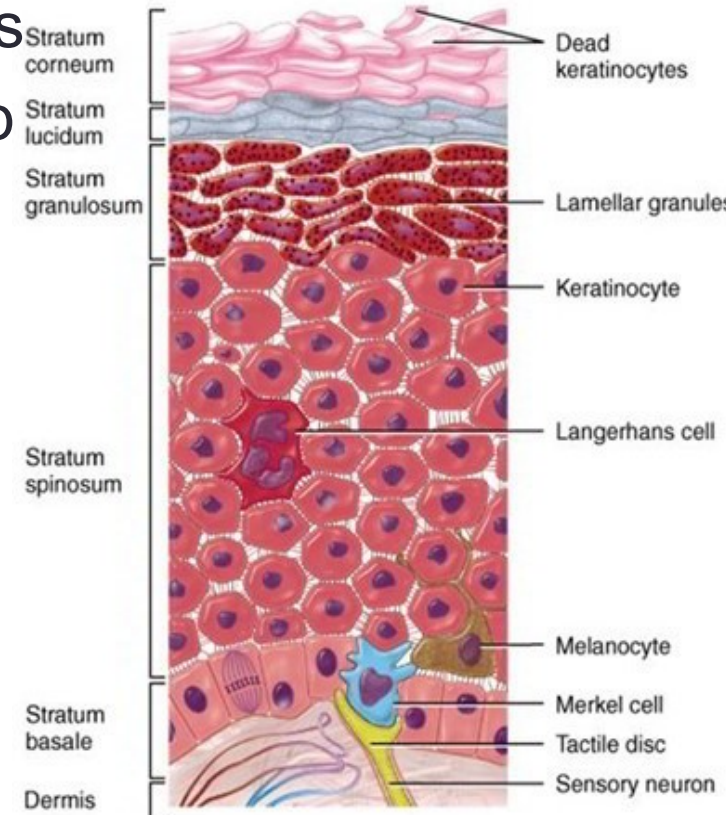
- the melanin is packaged into melanosomes in the Golgi apparatus and transferred to keratinocytes by dendrites

- melanocytes have long cell extension dendrites and can provide 30-40 keratinocytes with melanin

Tyrosine → Dopa → Dopakinone → Eumelanin, pheomelanin

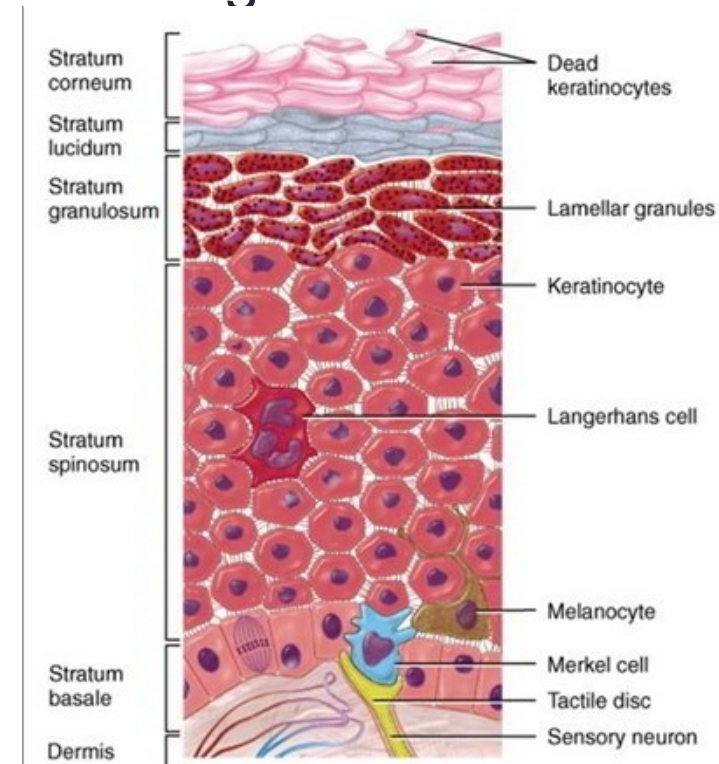
Langerhans cells

- antigen-presenting dendritic cells
- part of the body's immune system
- constantly on the lookout for antigens in their surroundings so they can trap them and present them to T-helper lymphocytes, thereby activating an immune response



Merkel cells

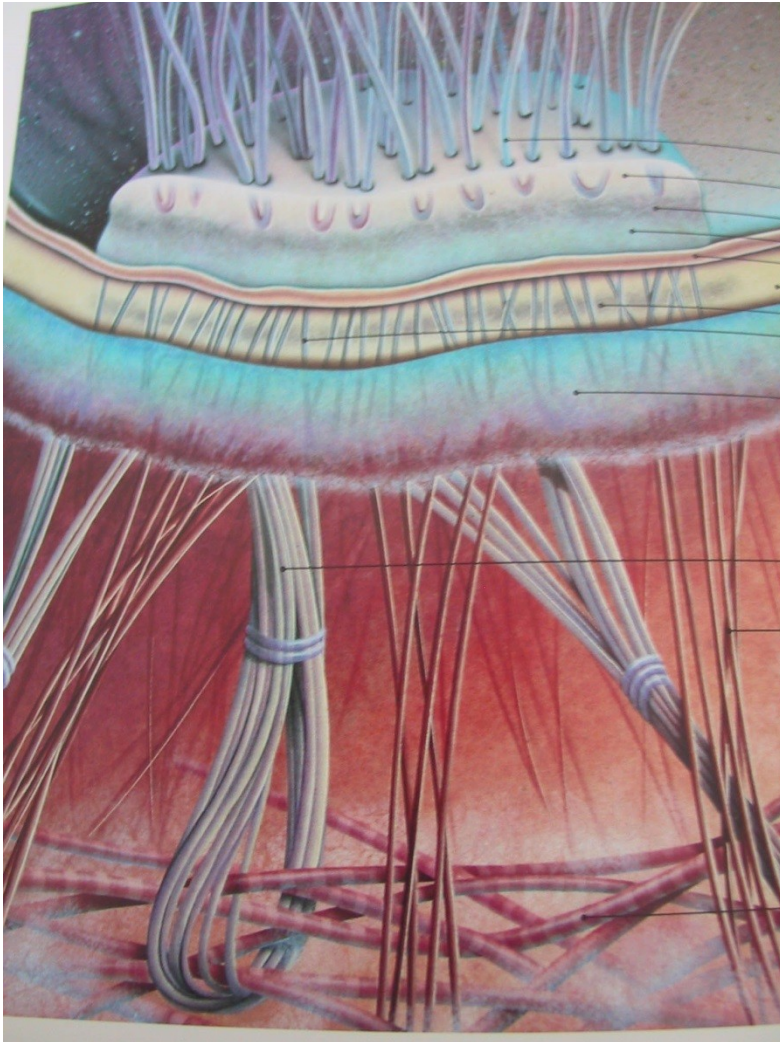
- present in very small numbers in the stratum basale
- closely associated with terminal filaments of cutaneous nerves and seem to have a role in sensation, especially in areas of the body such as palms, soles and genitalia



Types of cell junctions in the epidermis

- **desmosomes** – complex structures with many proteins holding cells together – the most important are the desmogleins
- **adherent junctions** - connect actin filaments and involve cadherins and catenins
- **gap junctions**

Dermo epidermal junction –basal membrane zone



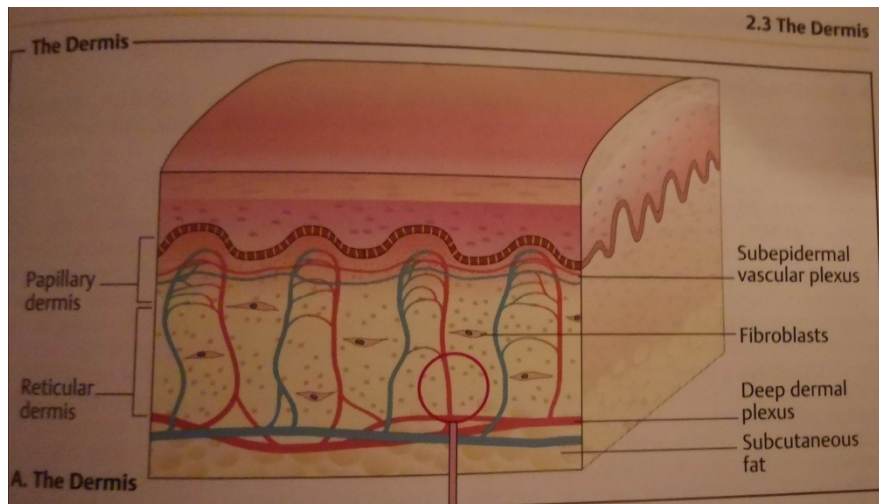
- narrow, undulating, multi-layered structure situated between the epidermis and dermis, which serve as cohesion between these two layers
- key components of the basal membrane zone – hemidesmosomes – junctional complexes, attach keratinocytes of str. basale to underlying basal membrane sharing many features with desmosomes
- is made up of lamina lucida and lamina densa
- barrier functions – allowing molecules to diffuse to and from the dermis

2. Dermis

- thickness: 0,6 – 3 mm
- connected to the epidermis at the level of the basal membrane
- consists of two layers, the papillar and reticular layer which merge together without clear demarcation
- contains: connective tissue
 - senzoric neurons
 - blood vessels
 - hair follicles and hairs
 - sweat glands

Layers of dermis

- Stratum papillare – formed into papilles orientated to epidermis, connective tissue with cells, elastic filaments, nerve endings, senzoric corpuscles - Meissner, Ruffini, ...
- Stratum reticullare – bigger part of the dermis, thick network of collagen and elastic filaments, less amount of cells, Vater-Pacini corpuscles



2. Dermis



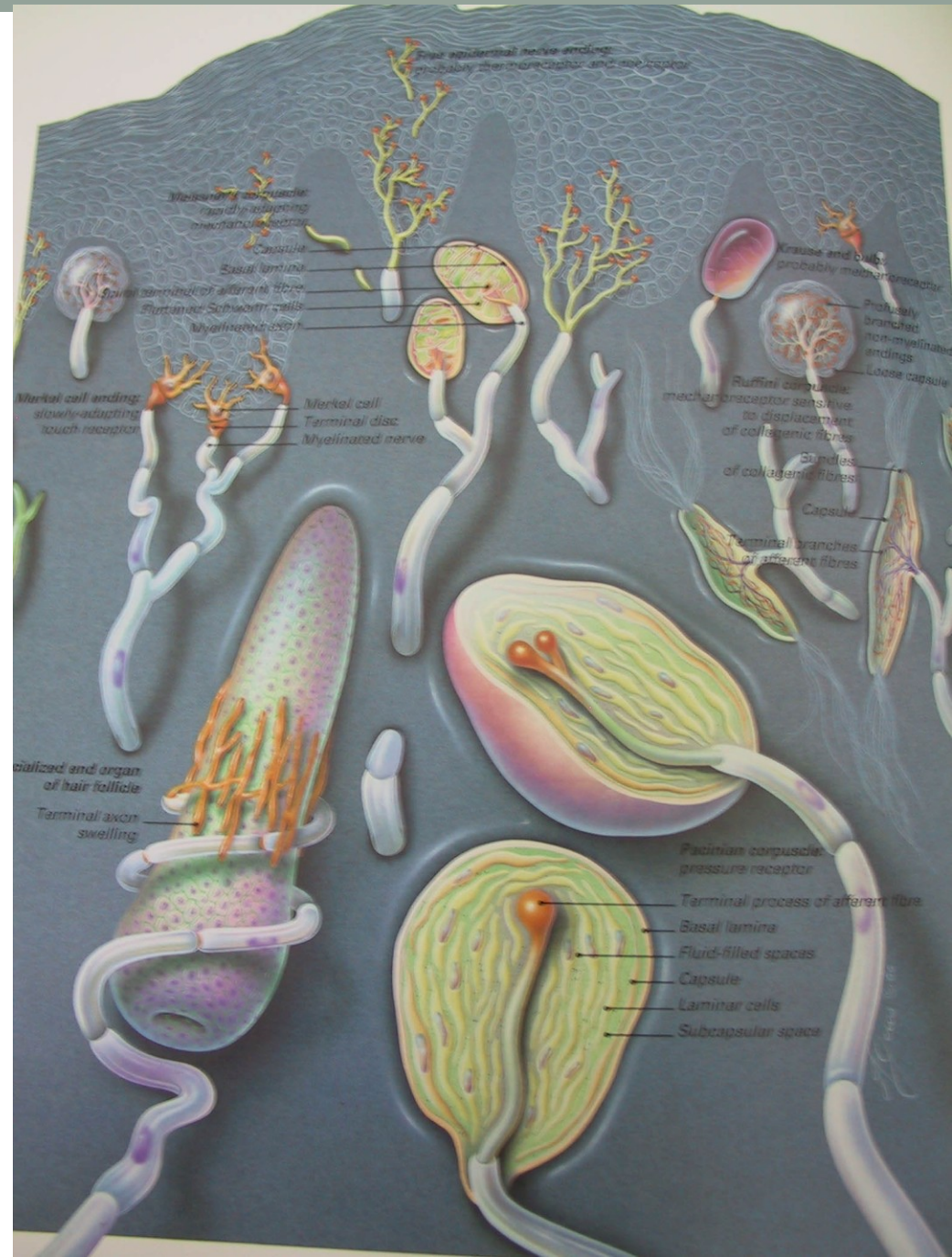
- the major structural component of the skin
- composed of collagen (strength), elastin (elasticity), blood/ lymph vessels and specialized cells called fibroblasts and mast cells.
- work together in a mesh like network.
- the network is surrounded by a gel-like substance called ground substance, which is made mostly from glycosaminoglycans (composed of hyaluronan, glycoproteins and proteoglycans), gel substance plays a key role in hydration and moisture level of the skin.

Types of cells in dermis

- 3 type of cells:
 - **Fibroblasts** - the synthesis of collagen and elastin
 - **Histiocytes** – created from monocytes (from blood vessels), active form call as mastocytes
 - **Mastocytes** – fagocyte antigens, release mediators (histamine, heparin, prostagaIndins, leukotirens, tryptase etc.)

Inervation of skin

- Nerve endings
- Merckels cells
- Sensitive corpuscles
 - heat
 - cold
 - pressure
 - vibrations
 - touch
 - itch
 - pain



Adnexal structures

- Hair
- nails
- glands (eccrine, apocrine, sebaceous)

- most of these adnexal structures is localized in dermis

The adnexal glands

- **Eccrine glands**

- widely distributed over the body, mostly concentrated on palms and soles, they can't be found on the lips, external ear canal, clitoris and labia minora
- „skin kidneys“ – sweat is usually clear and odorless

- **Apocrine glands**

- associated with hair follicles, their secretory duct empties into the upper part of the hair follicle
- sweat is odoriferous due to bacteria
- found in armpits, anogenital area and areolas

The adnexal glands

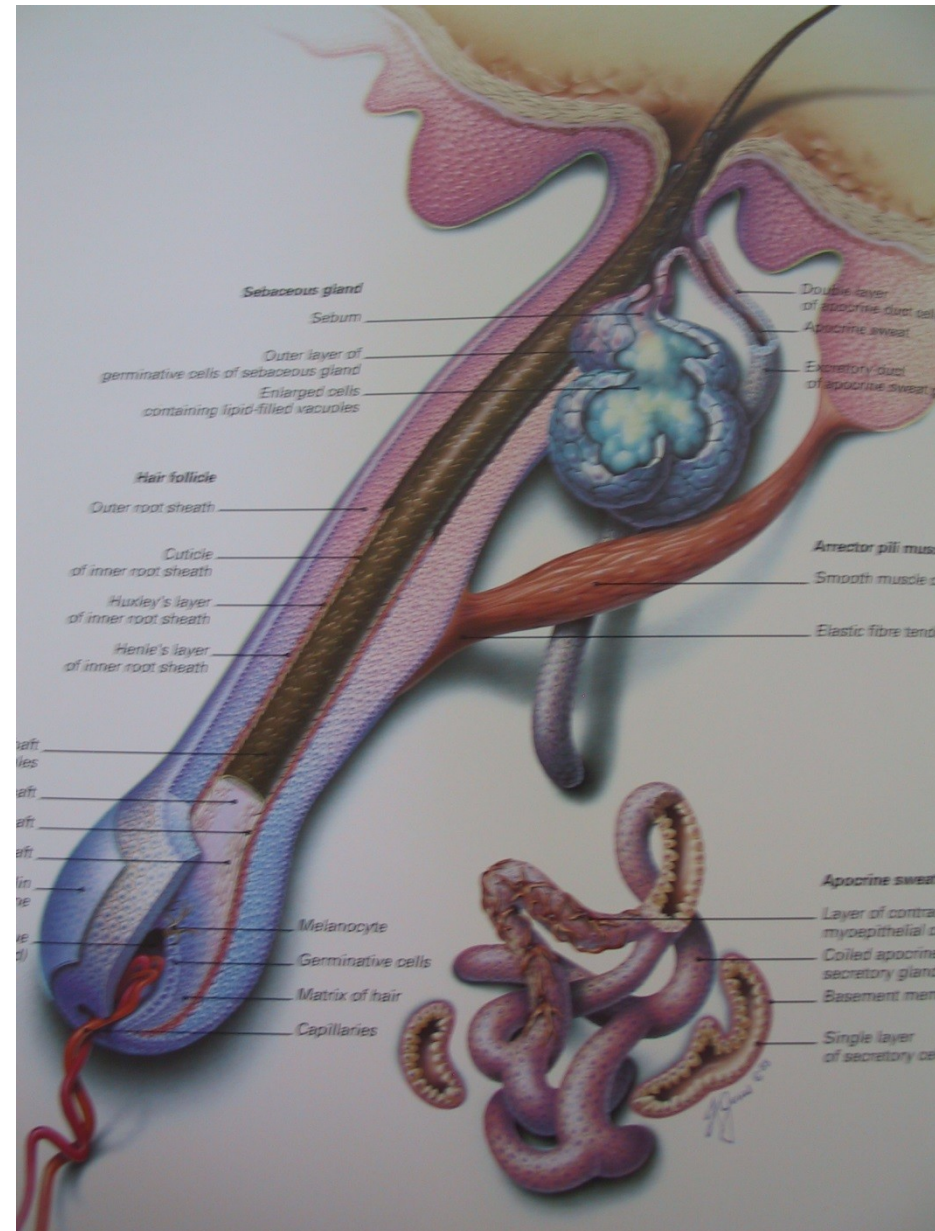
- **Sebaceous glands**
 - associated with hair follicles
 - sebaceous localization
 - their secretion lubricates the follicle to allow the hair shaft to grow outwards against less resistance
 - androgen sensitive

Hairs

- first hairs start to grow in the 20.th. week of pregnancy - lanugo
- the number of hair follicles is final after birth, new follicles aren't produced
- there is 5 milion hair follicules on human body (on head approx. 100 000)

Pilosebaceous unit

- The lower part of the follicle is extended into the bulbus, there is the papilla with capillaries, above the papilla germinative matrix and its cells differentiate to other layers of the follicle and from this part to the growing hair
- Hair is Inside of the follicle, consisting of medula, cortex a cuticula
- Around hair there is inner root sheath, which ends under opening of ductus of sebaceous gland to follicule
- Musculus arrector pili – is under the ductus of sebaceous gl., isn't on beard, axillar and pubic hair



The hair cycle

- Include:
 - anagen – growing phase (2-6 years)
 - katagen – (days – weeks)
 - telogen - (2-4 months)
- Colour of the hair – depends on numbers and activity of melanocytes in hair follicule

Types of hairs

- Lanugo - starts to grow in the 20.th. week of pregnancy
- Velus hair – change from lanugo after birth
- Terminal hair – has more pigment, is stronger, contain medula

pili longi – capillus (pilus capitis)

barba

hirci

pubes

body hairs

pili breves – cilia

supercilium

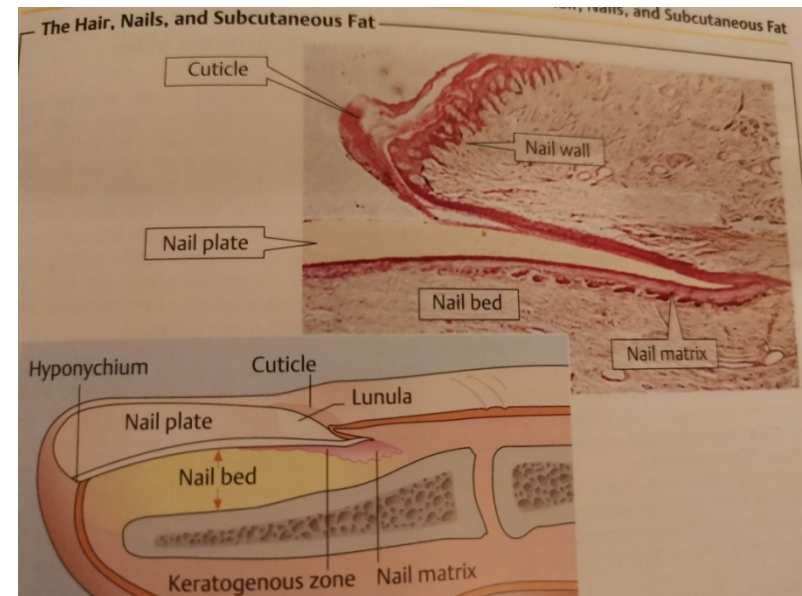
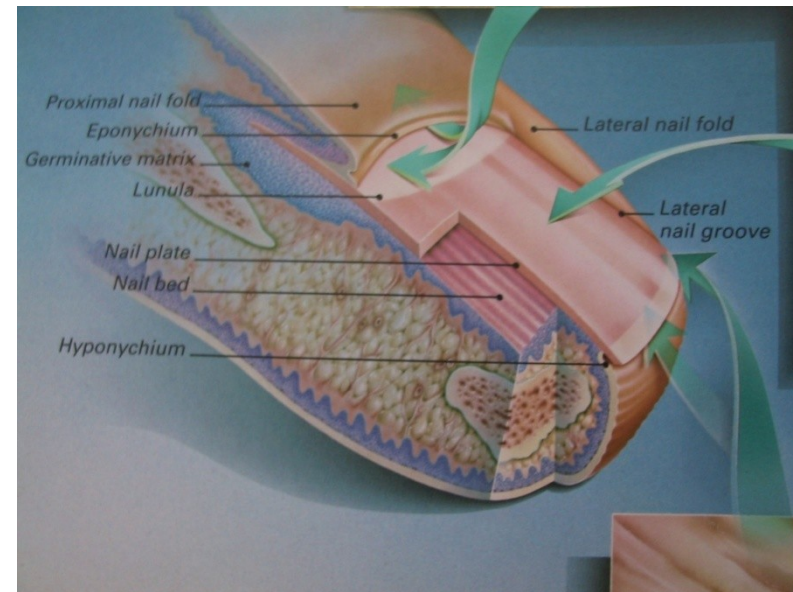
vibrisae

tragi

The nail

- consists of the nail matrix, nail plate, nail bed and periungual skin (paronychium)
- the nail matrix – growth zone of the nail
- the nail plate – is sealed proximally by the cuticle (eponychium) and laterally by the nail folds

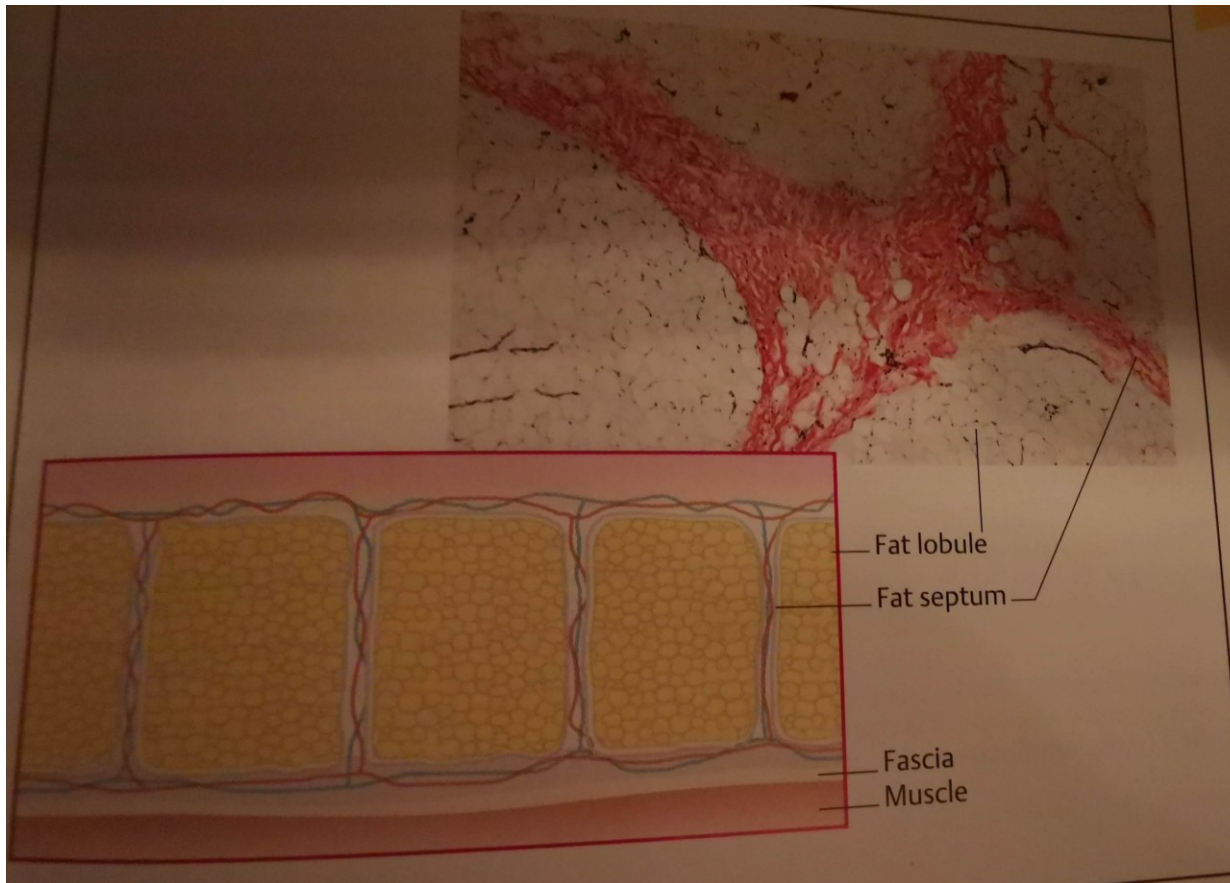
- nails grow slowly, a finger nail requires 4-6 months to replace itself, toenail 2-18 months, grow faster at night, in summer, in young than in the elderly, and in men than women



3. Subcutis

- lies between the dermis and muscle fascia, tendons or ligaments
- consists of adipocytes and connective tissue
- the subcutis contains numerous connective tissue septae which carry lymphatics and blood vessels and nerves
- the network of septae keeps the lobules of fat in place and provides support
- adipocytes are metabolically active

3. Subcutis



Skin functions

- Protection
- Thermoregulation
- Storage
- Sensation
- Metabolism
- Immunological processes
- Detoxification
- Social function

The function of the skin

Protection against

- chemicals
- physical factors
(mechanical, thermic, actinic)
- Biological factors
(Infections, antigens)

- epidermal barrier

Preservation of balanced internal environment

- Loss of water, electrolytes, macromolecules

- horny layer, water reservoir, sweat gland,...

The function of the skin

Temperature regulation

- perspiration
- vasodilatation
- vasoconstriction

- blood vessels, eccrine sweat glands

Sensation

- thermoreceptors – cold and heat
- mechanoreceptors – touch, pressure, vibrations
- nociceptors – pain and itch

Storage (fat, water)

- energy reservoir - subcutaneous fat

The function of the skin

Metabolic – vitamin D synthesis, metabolism of carbohydrates, lipids and proteins, secretion of keratin, melanin, sebum, sweat

Immunological function

Psychosocial function

- Keratinocytes
- Langerhans cells, T-lymphocytes, macrophages, mastocytes, keratinocytes
- Cosmetic quality, lips, hair

THANK YOU FOR YOUR
ATTENTION

You can find the overview here: <https://www.youtube.com/watch?v=MPLV4h0Tr8c>