

Kožní pokryv
(Integumentum commune)

=

Kůže a kožní deriváty (adnexa)

Aleš Hampl

Funkční jednotka

Největší tělní systém

16% váhy těla

1,5 až 2 m²

**Integumentum
commune**

=

Kožní povrch

Cutis
=
Kůže

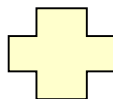
Epidermis - rohovatějící vrstevnatý
dlaždicový epitel

Dermis = Škára - vazivová složka

Tela subcutanea

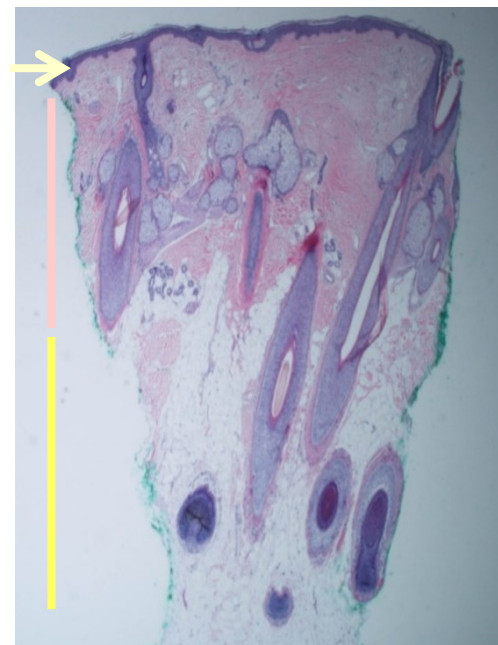
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Subcutis - Podkoží



Kožní adnexa
deriváty epidermis

- vlasy a nehty
- kožní žlázy (mazové + potní)
- mléčná žláza



Kůže = Kombinace 4 tkání

- Epitelová - outer layer
- Pojivová - underlies dermis
- Hladkosvalová - goose bumps
- Nervová - sensory receptors

Functions of the skin

1. Regulation of body temperature

Cellular metabolism produces heat as a waste product .

High temperature

dilate surface blood vessels

sweating

Low temperature

surface vessels constrict

shivering

2. Protection

physical abrasion

dehydration

ultraviolet radiation

3. Sensation

touch

vibration

pain

temperature

4. Excretion

5. Immunity/ Resistance

6. Blood Reservoir

8-10 % in a resting adult

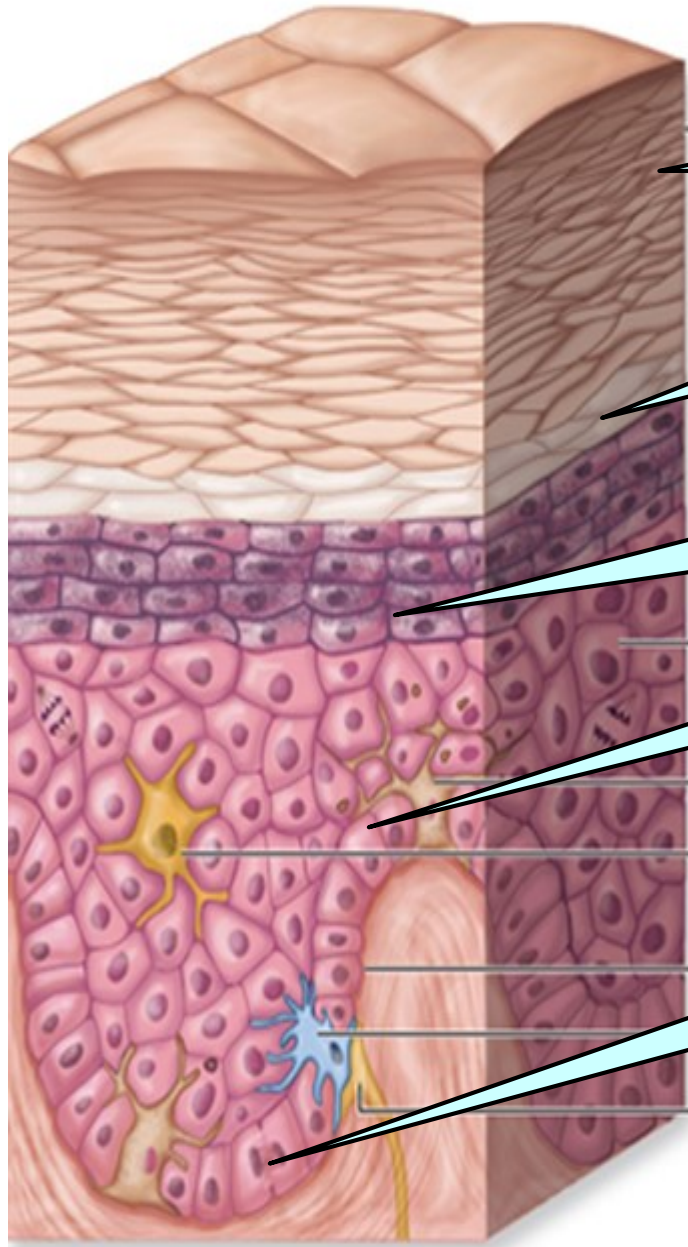
7. Synthesis of vitamin D

uv light

aids absorption of calcium

Epidermis - Vrstvy

Keratinizující vrstevnatý dlaždicový epitel (keratinocytes - 4 or 5 layers)



5. Stratum corneum

- dead, flat cells full of keratin (25 to 100 layers)
- **corneodesmosomes**
- **polar lipids** - ceramides

4. Stratum lucidum

- more apparent in thick skin
- 3-5 layers of clear cells
- transitional state

3. Stratum granulosum

- 3-5 layers
- **tight junctions** = zonulae accludentes
- keratohyalin found in granules
- cells beginning to die
- keratohyalin and lamellar granules

2. Stratum spinosum

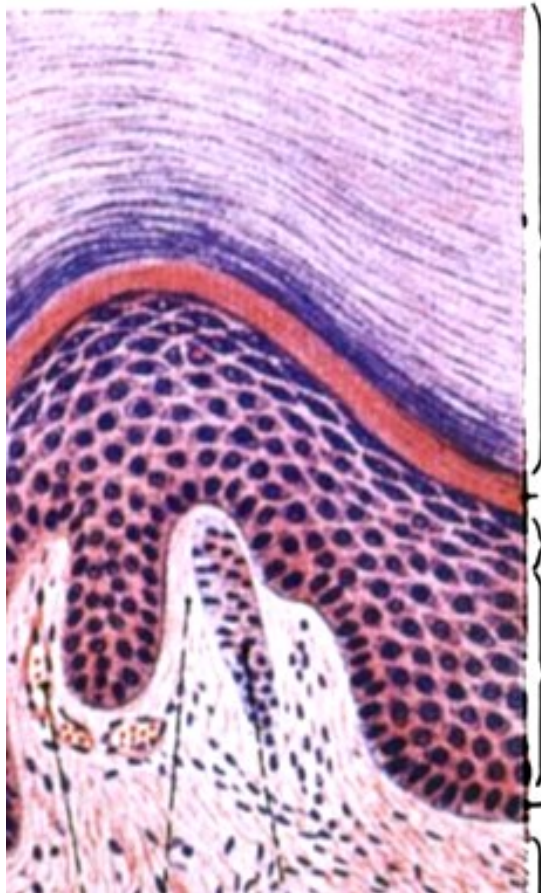
- polygonal cells (keratines 1 and 10)
- 8-10 layers of keratinocytes
- **desmosomes** – shrinkage - spines

1. Stratum basale (germinativum)

- cylindrical cells – one layer (keratines 5 and 14)
- stratum germinativum
- the only proliferating cells (stem, progenitor)
- **hemidesmosomes**

Desquamation = Maturation (about 25 days)

Mnemotechnická pomůcka



Stratum **C**orneum

Stratum **L**ucidum

Stratum **G**ranulosum

Stratum **S**pinosum

Stratum **B**asale

Cancel

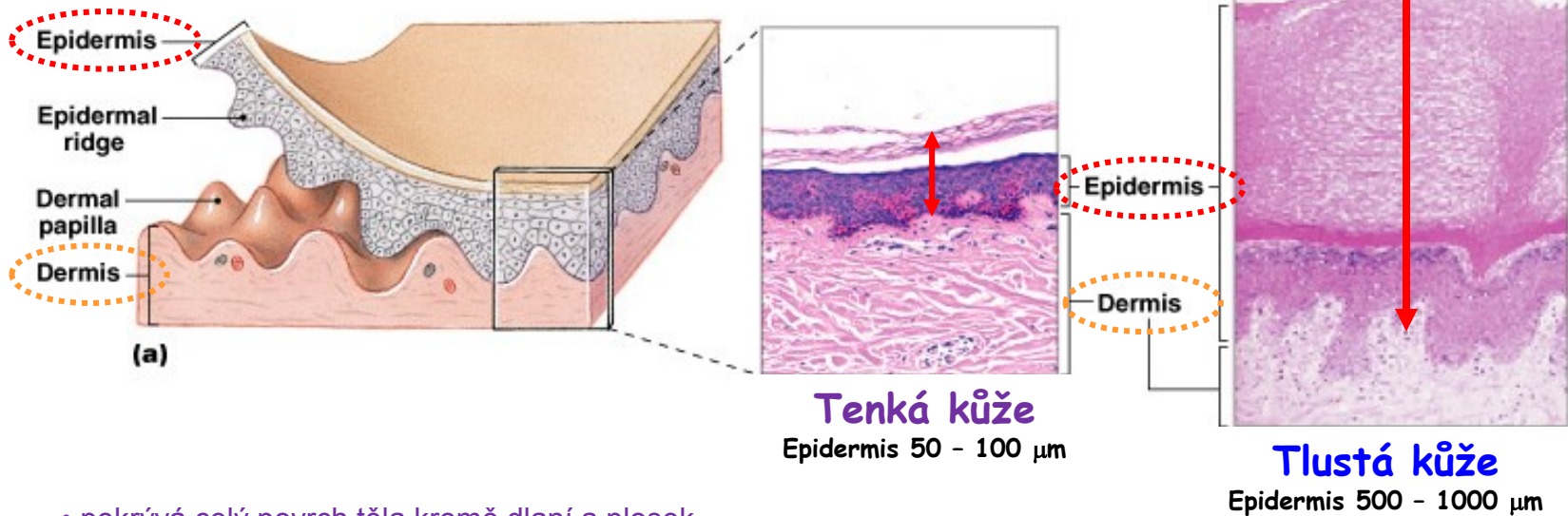
Lab !!!

Get

Some

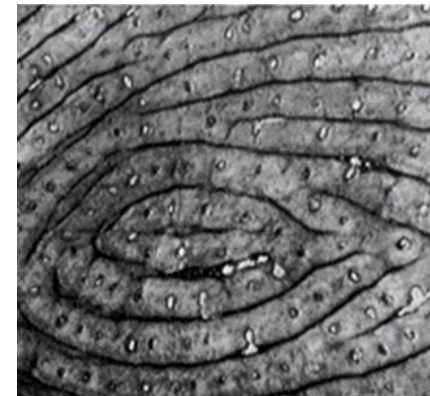
Beer !!!

Epidermis (Pokožka) - Tenká x tlustá kůže

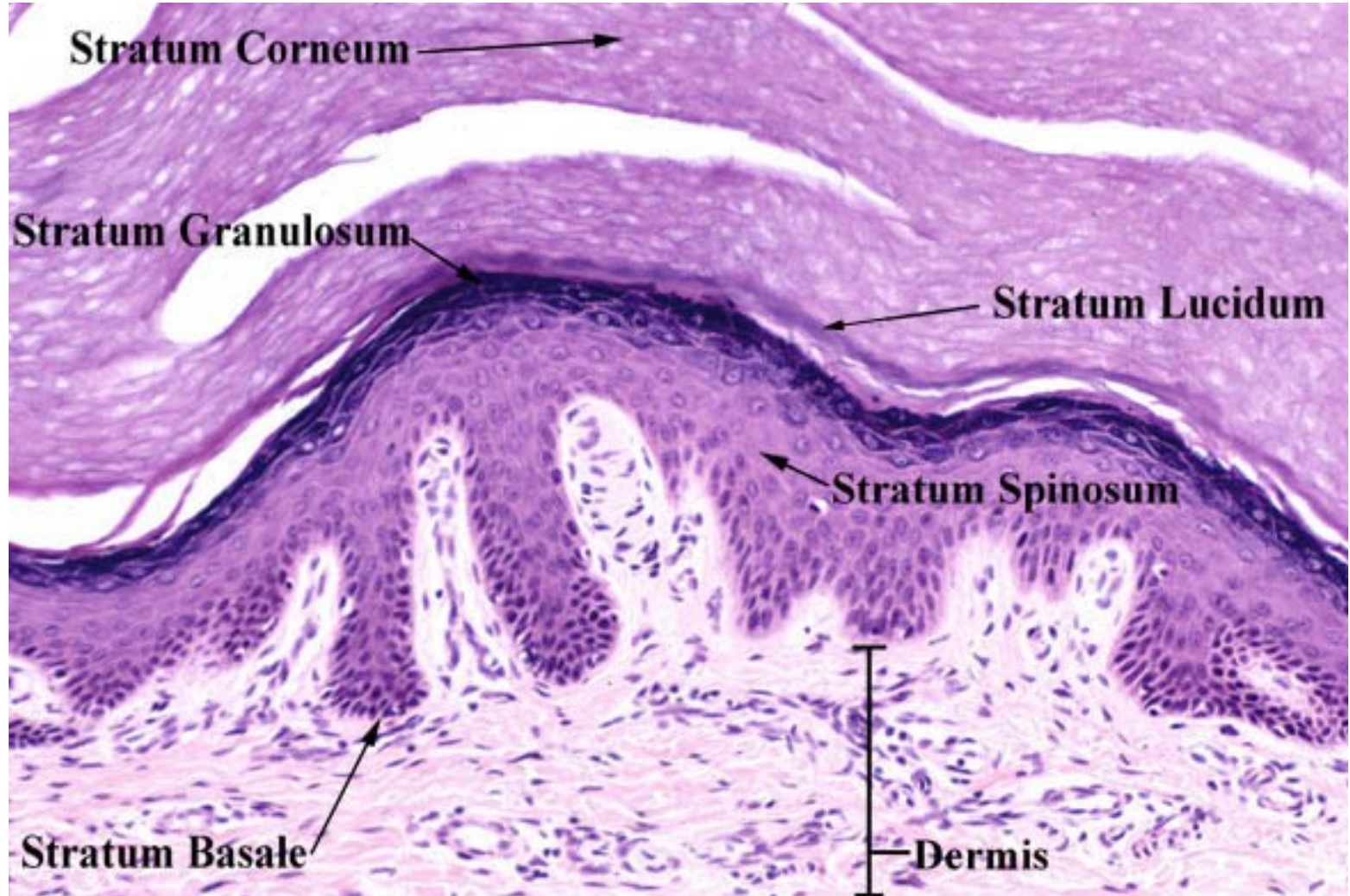


- pokrývá celý povrch těla kromě dlaní a plosek nohou
- typické **kosočtverečné políčkování**
- stratum corneum - méně než 25 vrstev buněk
- stratum lucidum chybí
- adnexa: potní žlázy + mazové žlázy + chlupy (kromě rtů, glans penis, labia minora)

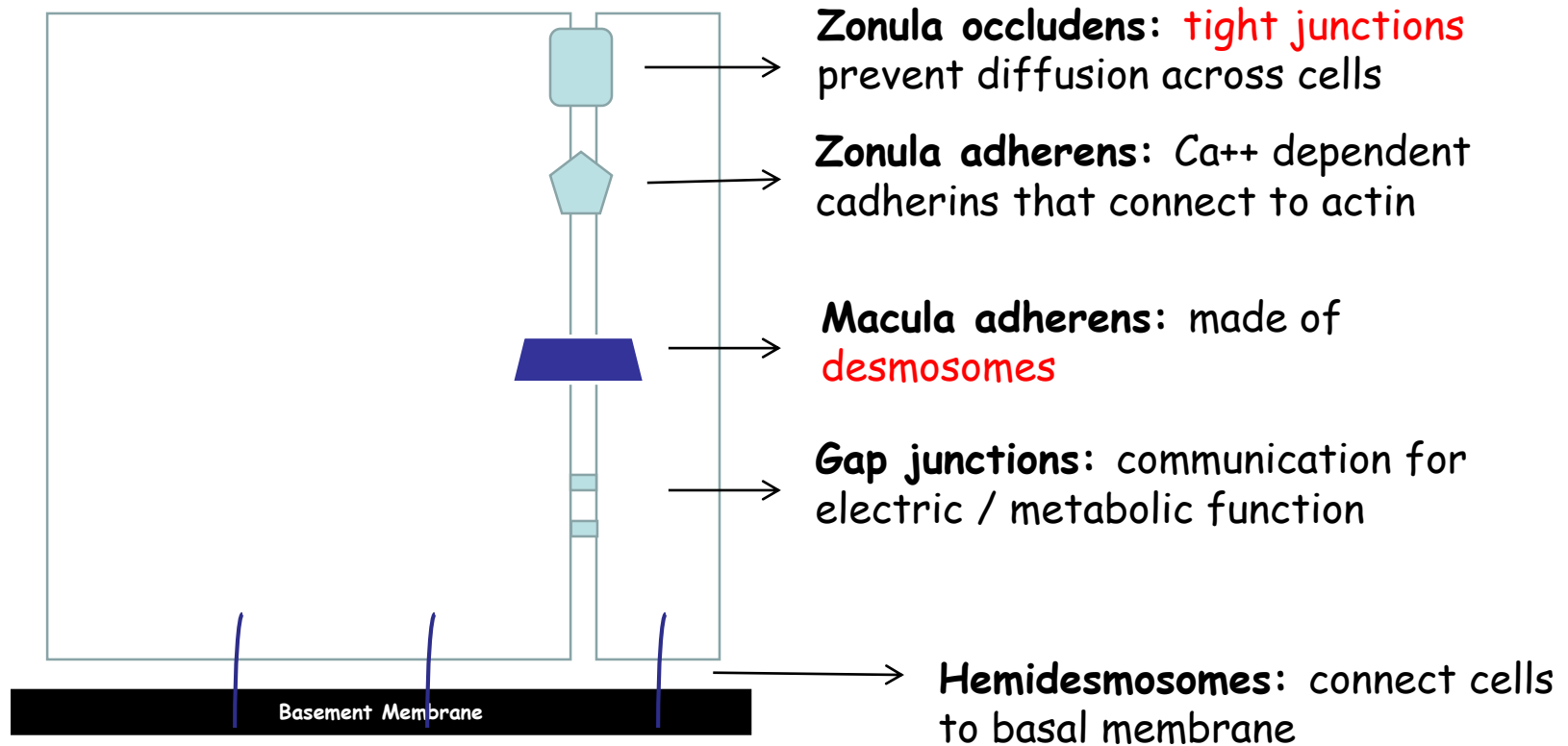
- pokrývá dlaně a plošky nohou – tzv. **akrální kůže**
- **hmatové lišty** →
- stratum corneum - 100 vrstev buněk
- stratum granulosum – zbytnělé
- adnexa: - pouze početné ekkrinní potní žlázy



Epidermis

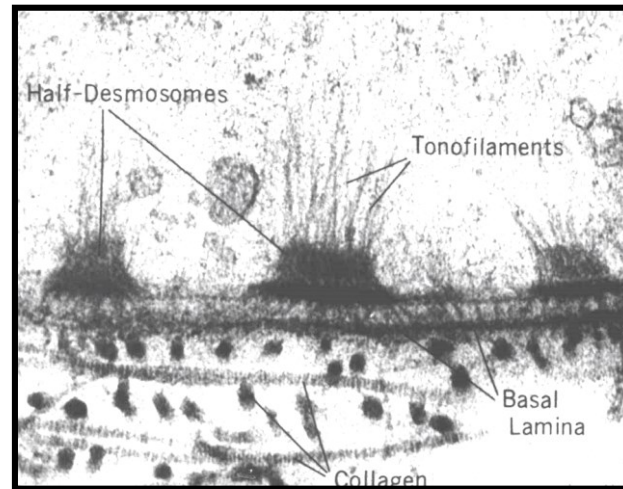
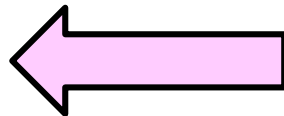
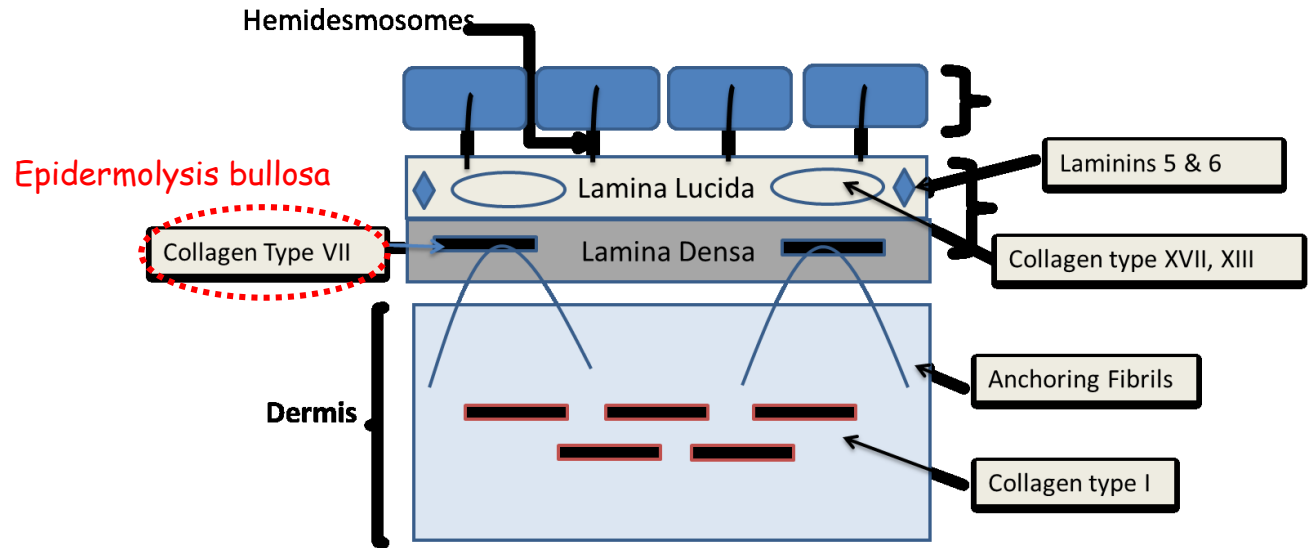
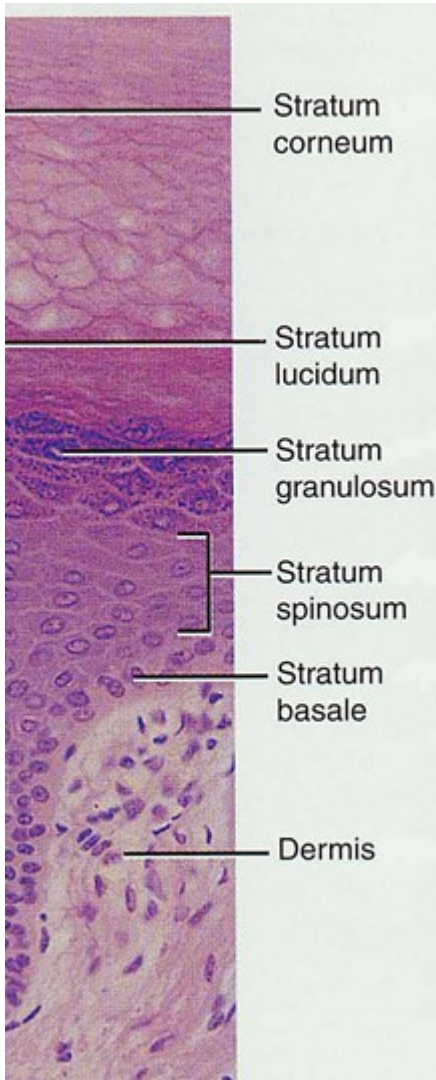


Epidermis - Mezibuněčné spoje

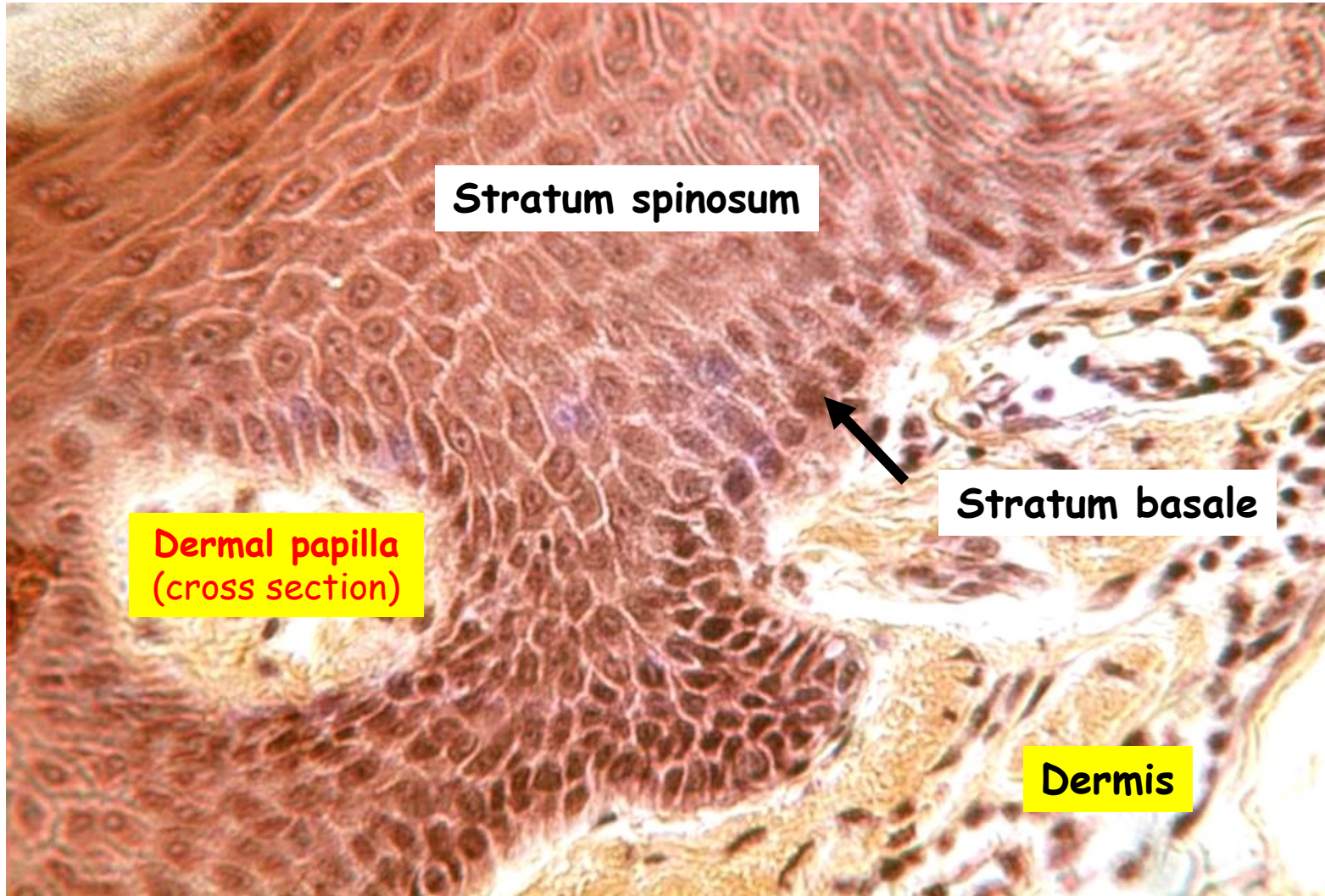


Spojení: Dermis - Epidermis

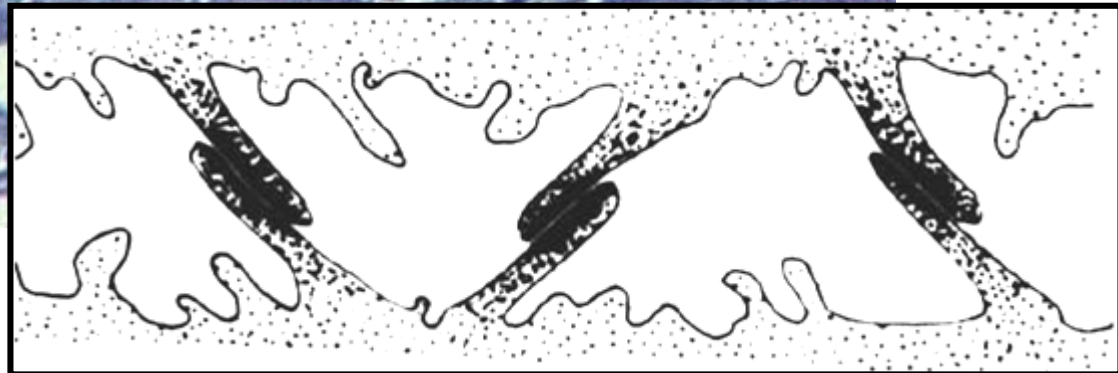
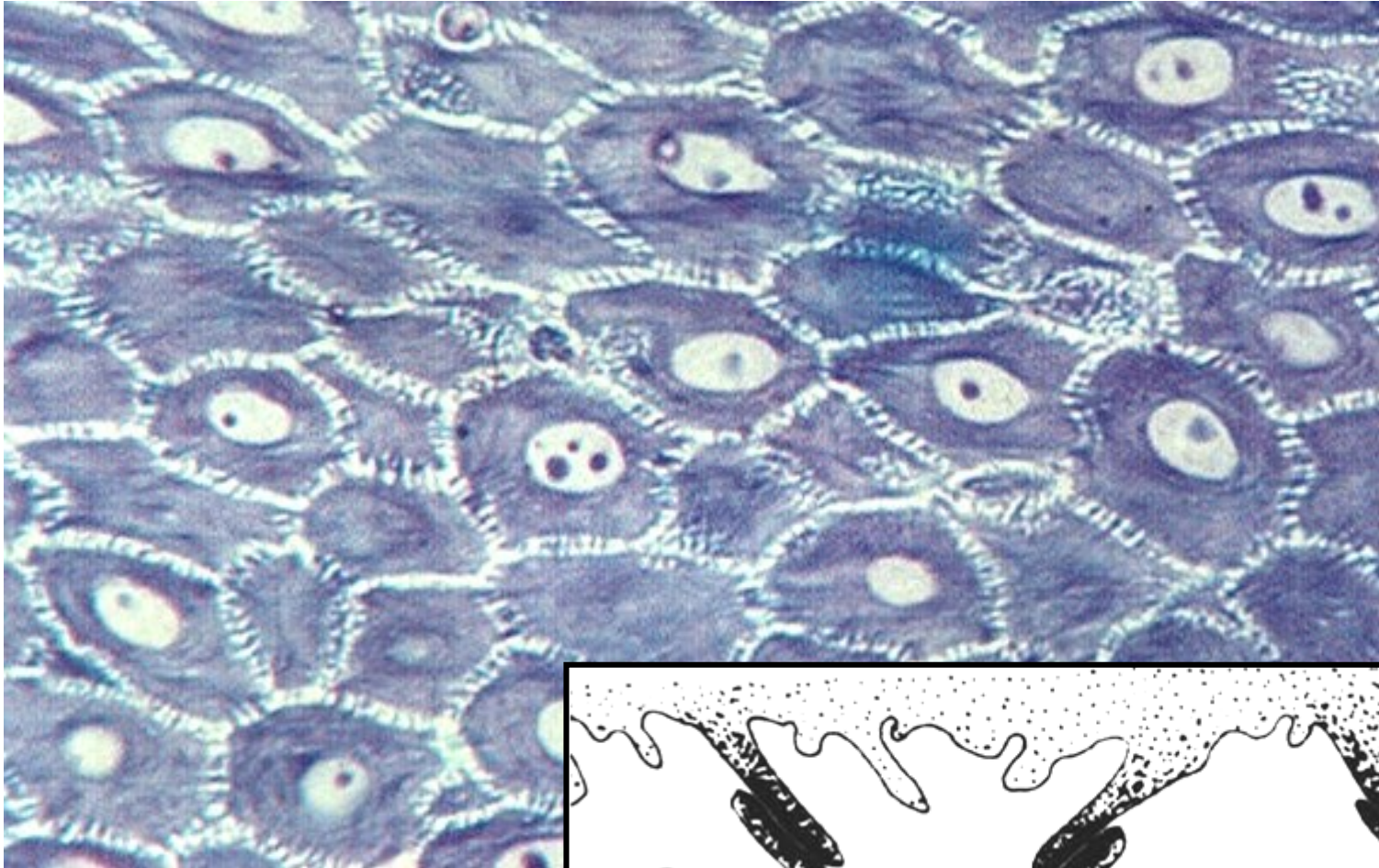
Hemidesmosomy



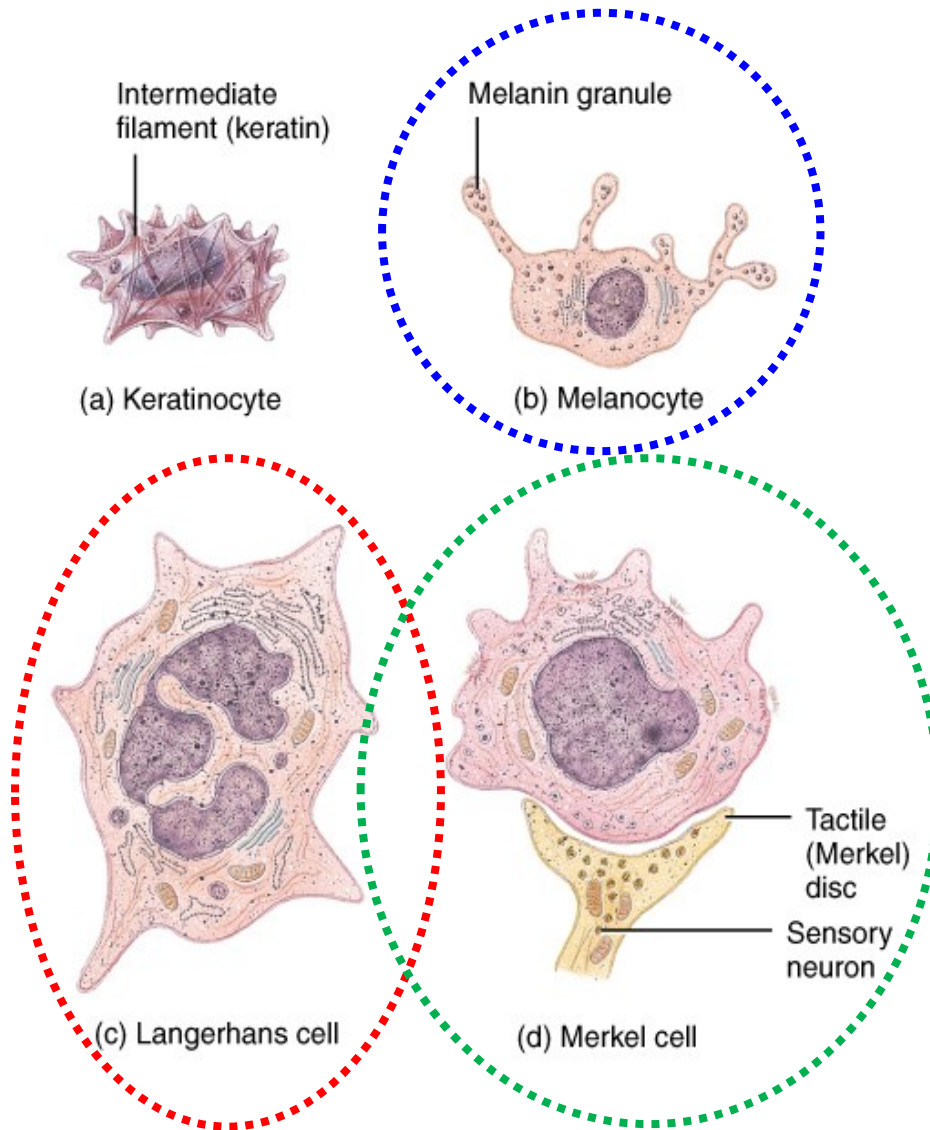
Epidermis - Stratum spinosum - Desmosomy



Epidermis - Stratum spinosum

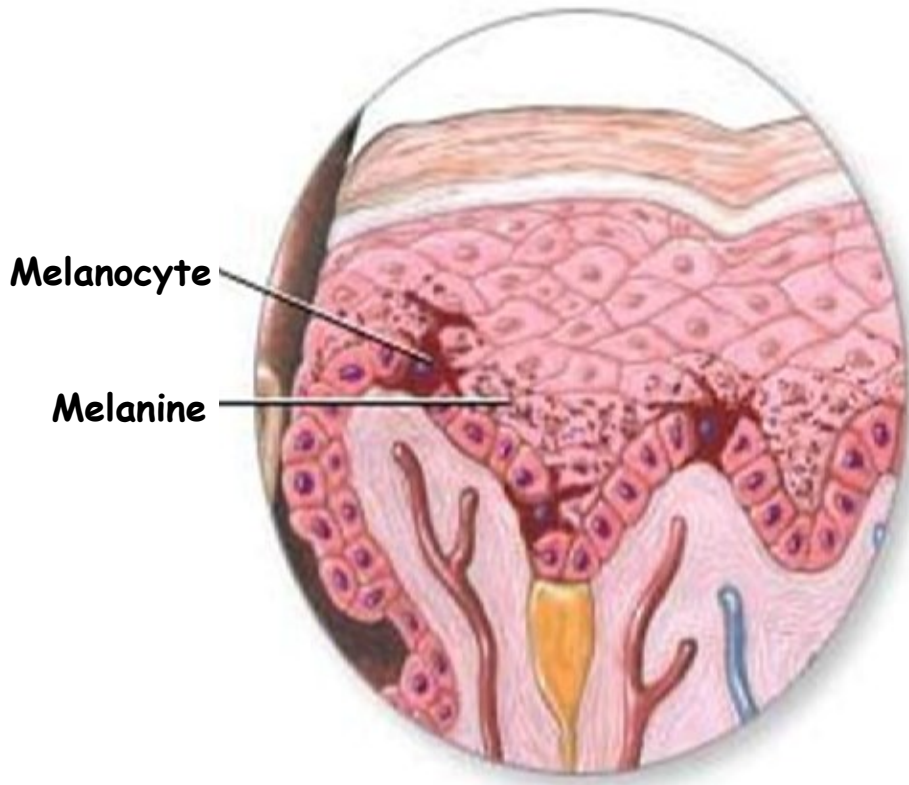


Epidermis - Nekeratizující buňky

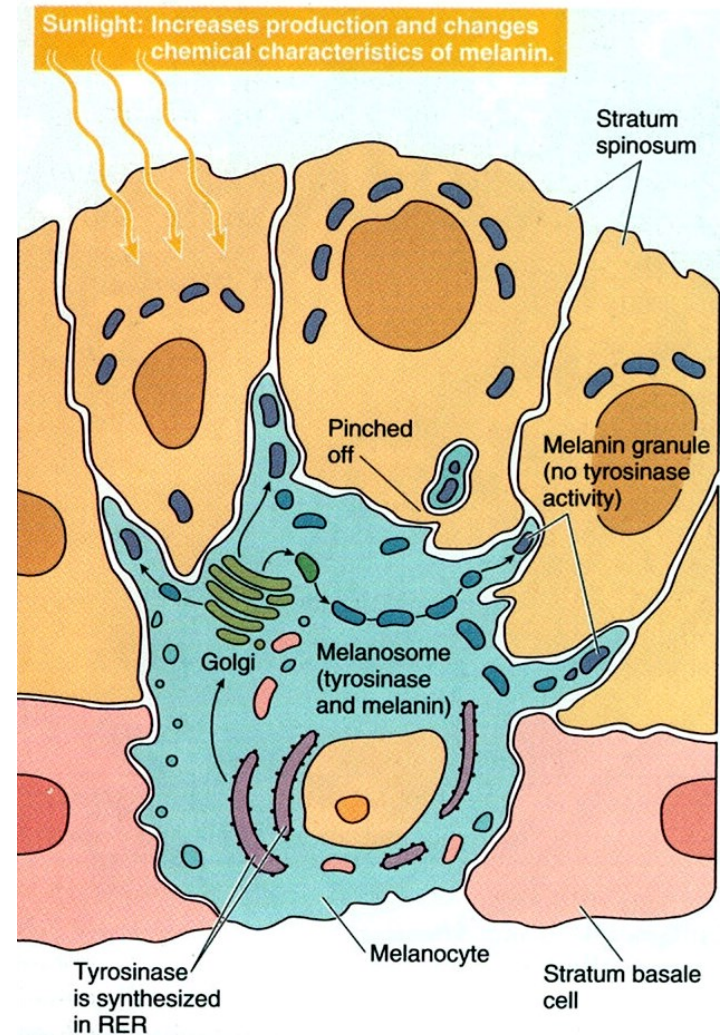


- **Keratinocyte** - 90%
 - produce keratin
- **Melanocyte** - 8 %
 - produces melanin pigment
 - melanin transferred to other cells with long cell processes
- **Langerhansovy buňky**
 - from bone marrow
 - provide immunity
- **Merkelovy buňky**
 - in deepest layer
 - form touch receptor with sensory neuron

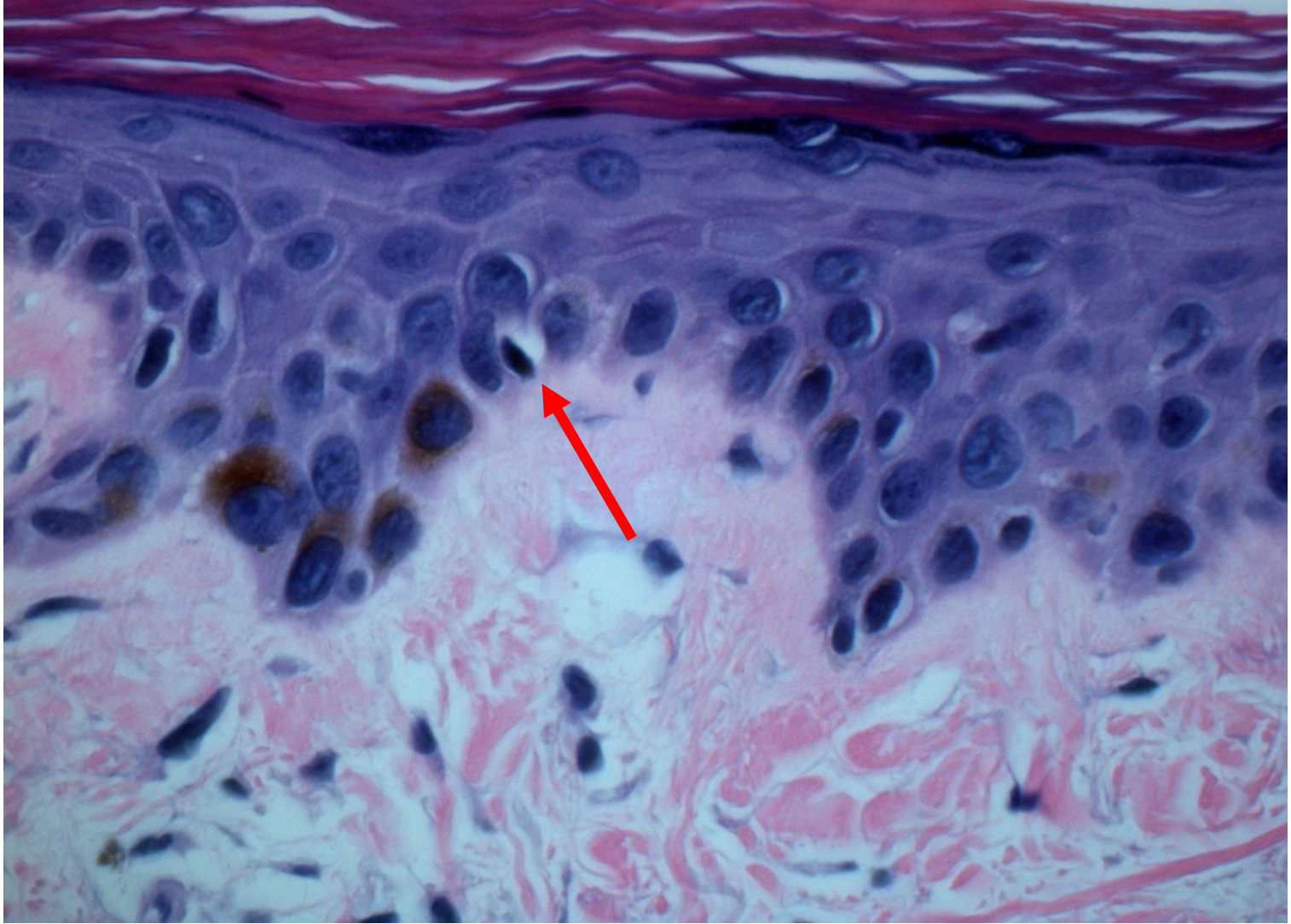
Epidermis - Melanocyty 1



Melanocytes: clearish cells in basal layer with dark nuclei ; ratio of 1 : 40 - epidermal melanin unit.



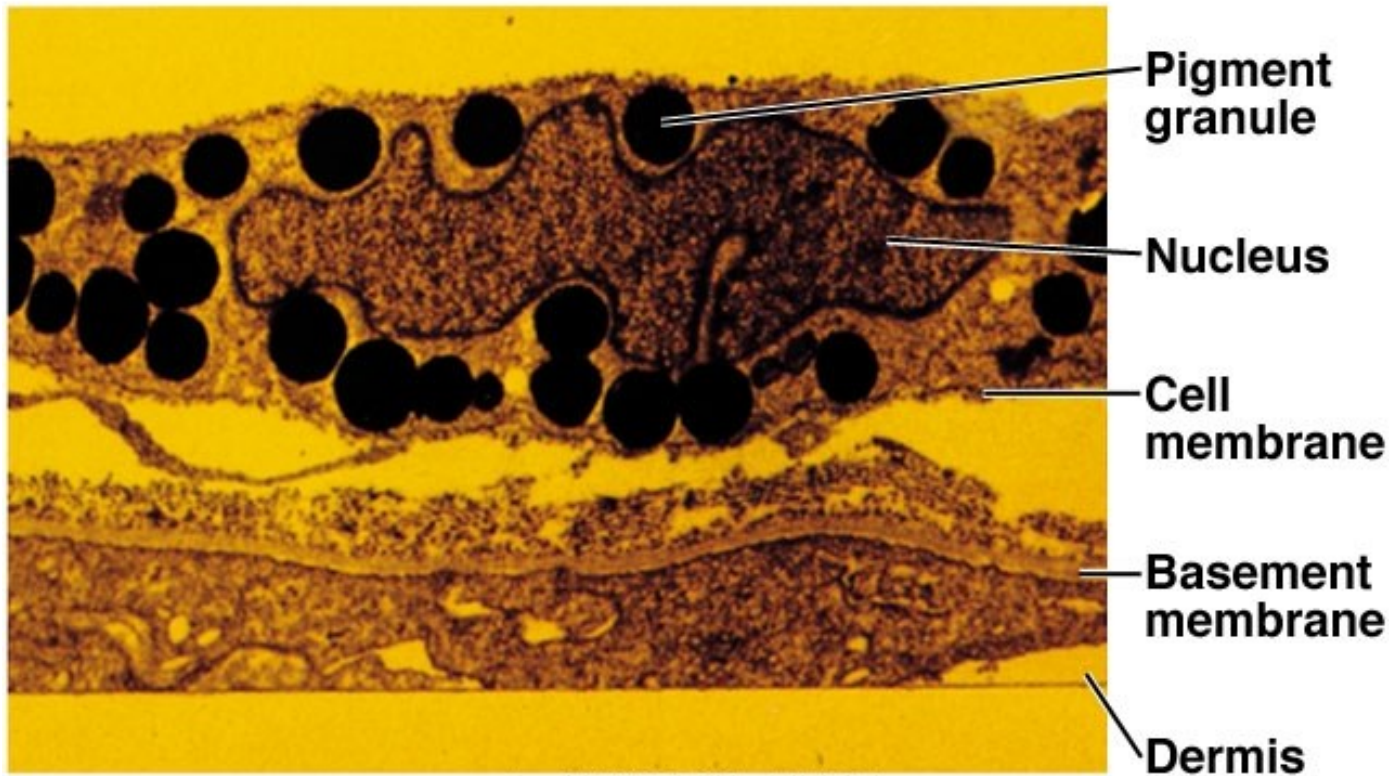
Epidermis - Melanocyty 2



Epidermis - Melanocyty 3

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Melanocyte with Pigment Granules



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Epidermis - Melanocytes 4 - Pigmentary

Three pigments contribute to skin color

Melanin - yellow to reddish-brown to black pigment, responsible for dark skin colors

(Freckles and pigmented moles - result from local accumulations of melanin)

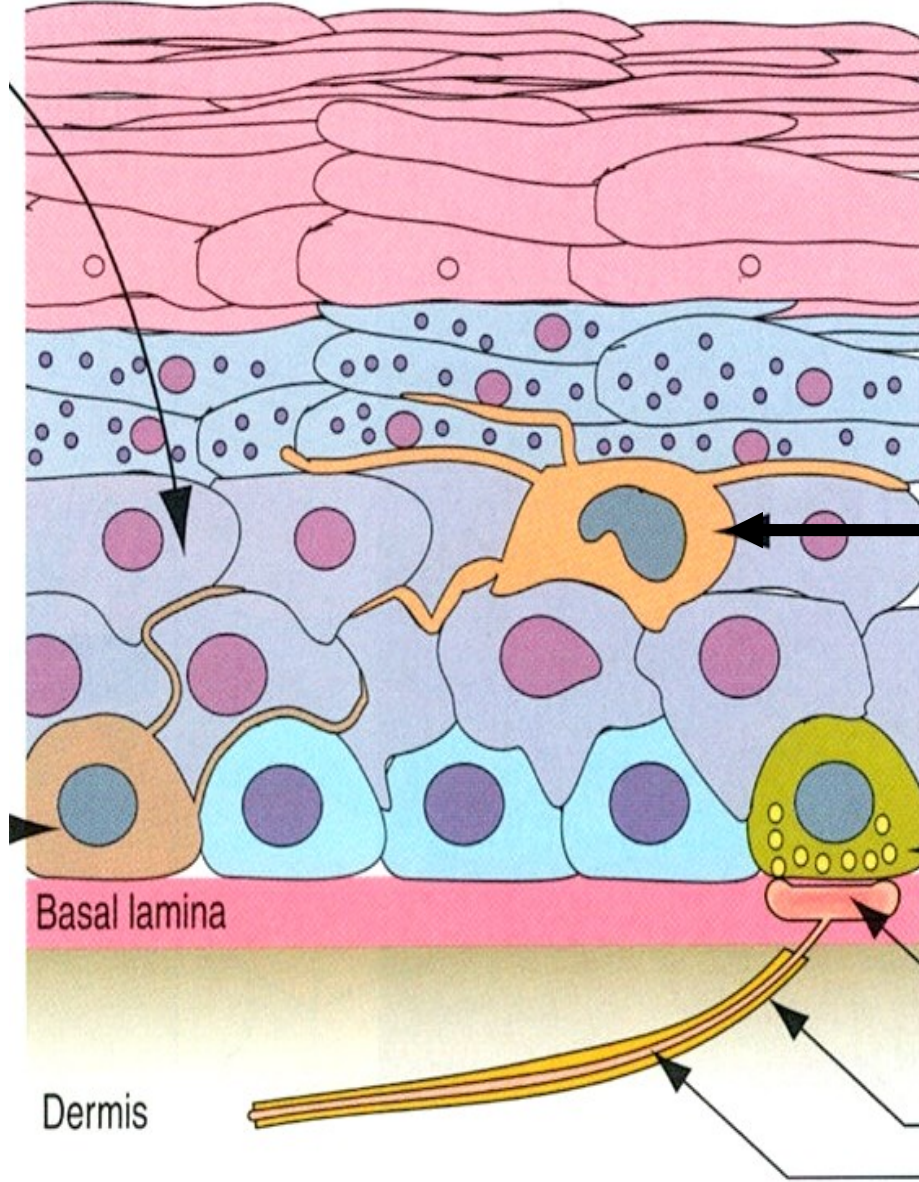
Carotene - yellow to orange pigment, most obvious in the palms and soles of the feet

Hemoglobin - reddish pigment responsible for the pinkish hue of the skin

Do some people have more melanocytes than other people?

NO !!!!

Epidermis - Langerhansovy + Merkelovy buňky



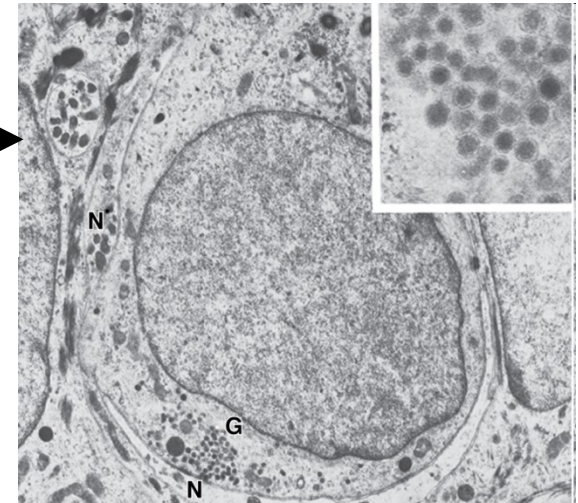
Migrate to lymph nodes

Langerhans cell

immunological reaction that effects the skin and may serve defense mechanism for the body

Merkel cell

combines with disclike sensory nerve endings to make Merkel's discs



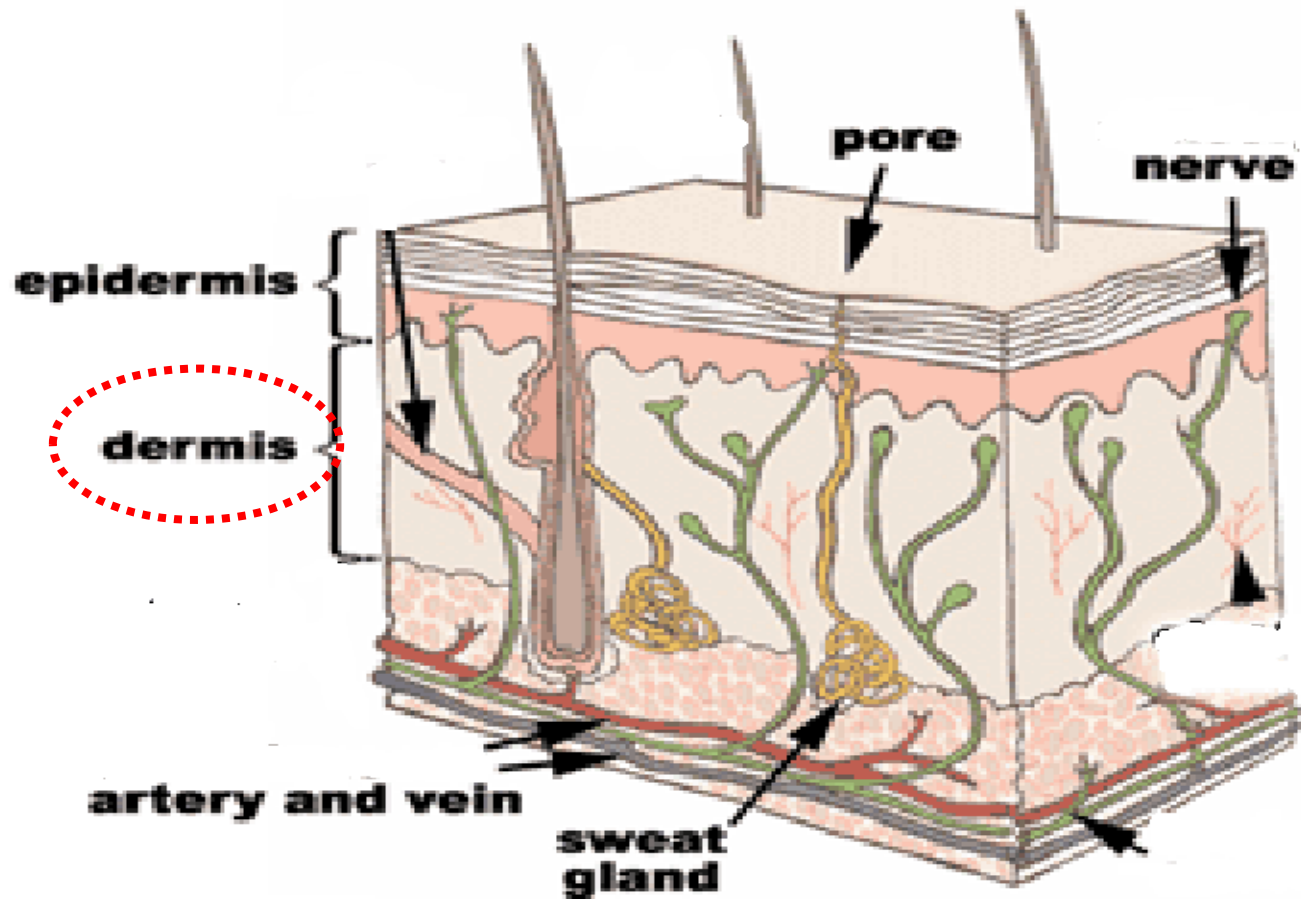
Basal lamina

Dermis

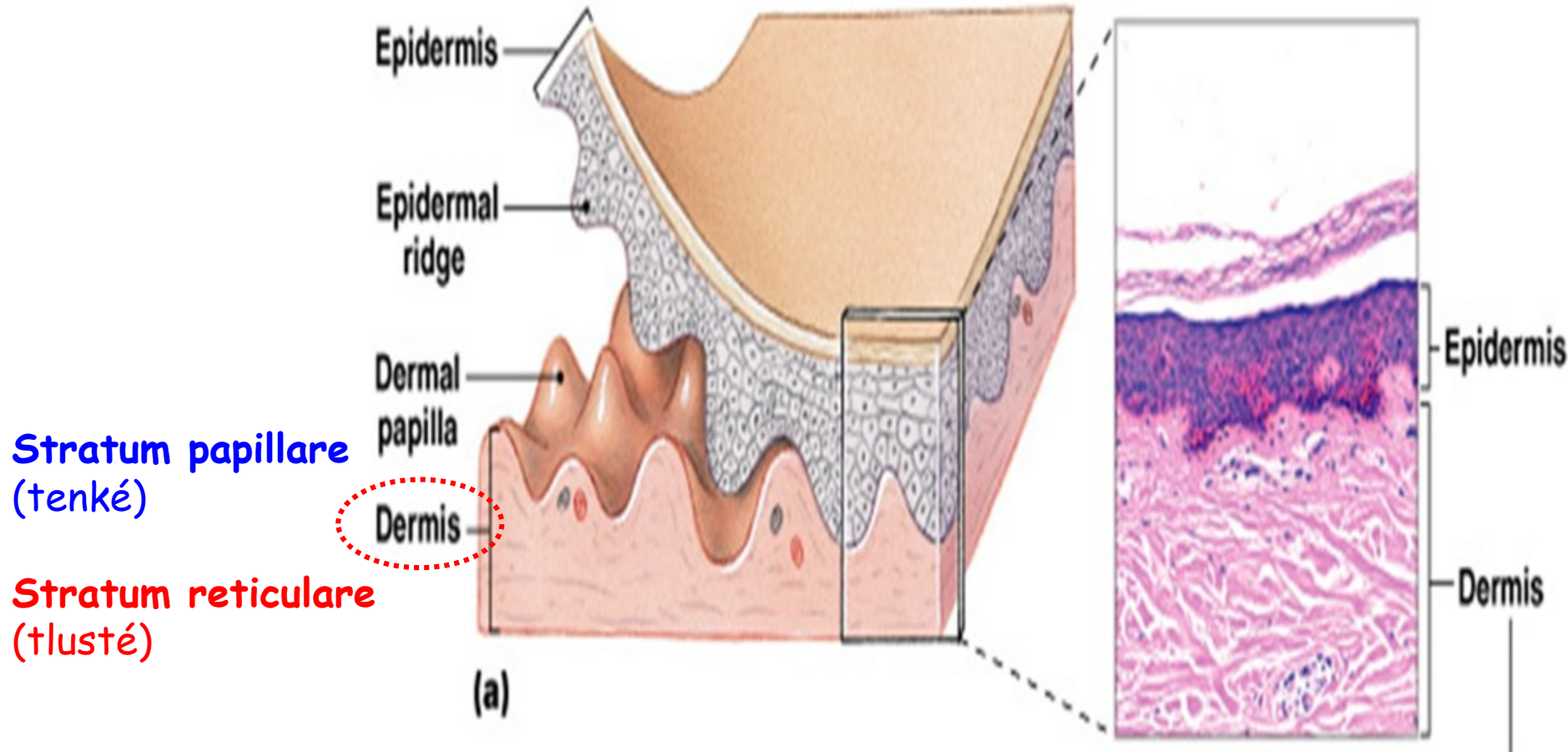
Dermis (škára) 1

Everything below the dermal-epidermal junction / basement membrane

Connective tissue layer with contains blood vessels, nerves, sensory receptors, adnexal structures

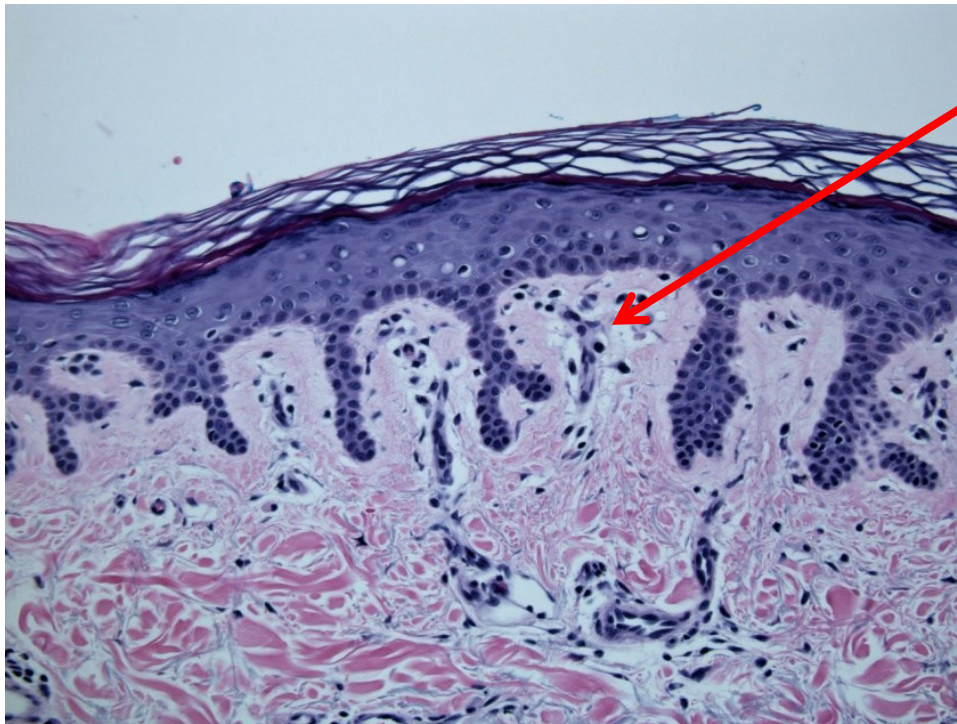


Dermis 2



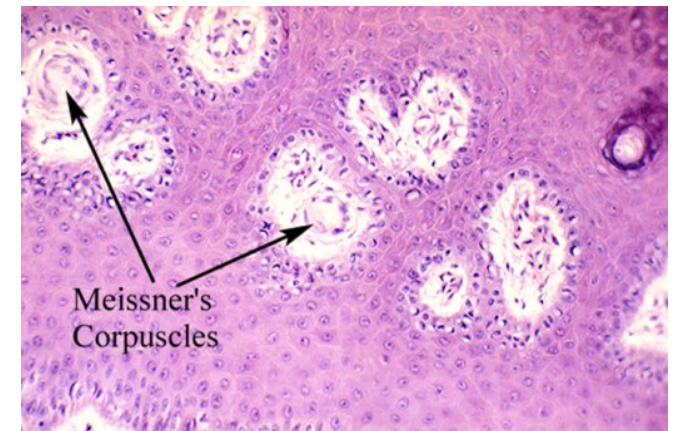
= až 4 mm na dlaních a ploskách nohy

Stratum papillare 1



Capillaries

Str. papillare

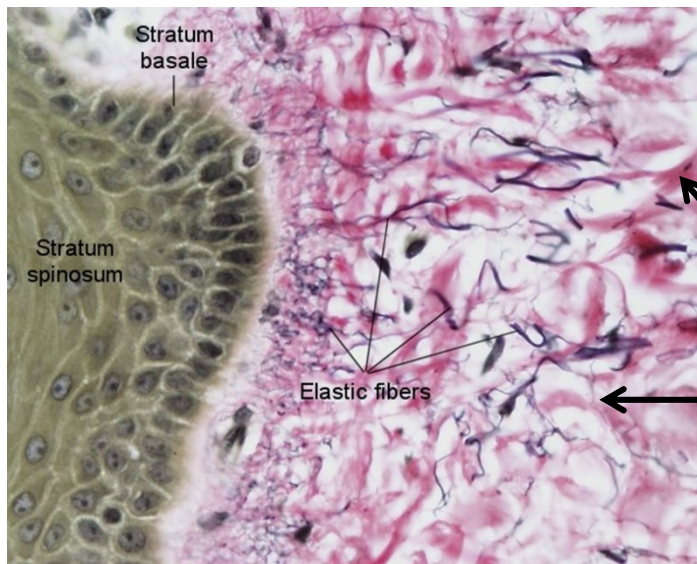


- Řídké vazivo & elastická vlákna
- **dermal papillae** which project into epidermis
- anchors epidermis to dermis
- contains **Meissnerova hmatová tělíska** (tlak) & **volná nervová zakončení** (bolest & teplota)

Stratum papillare 2

Two major types of fibers:

- Type I Collagen
- Elastic fibers: three types based on microfiber and elastin content

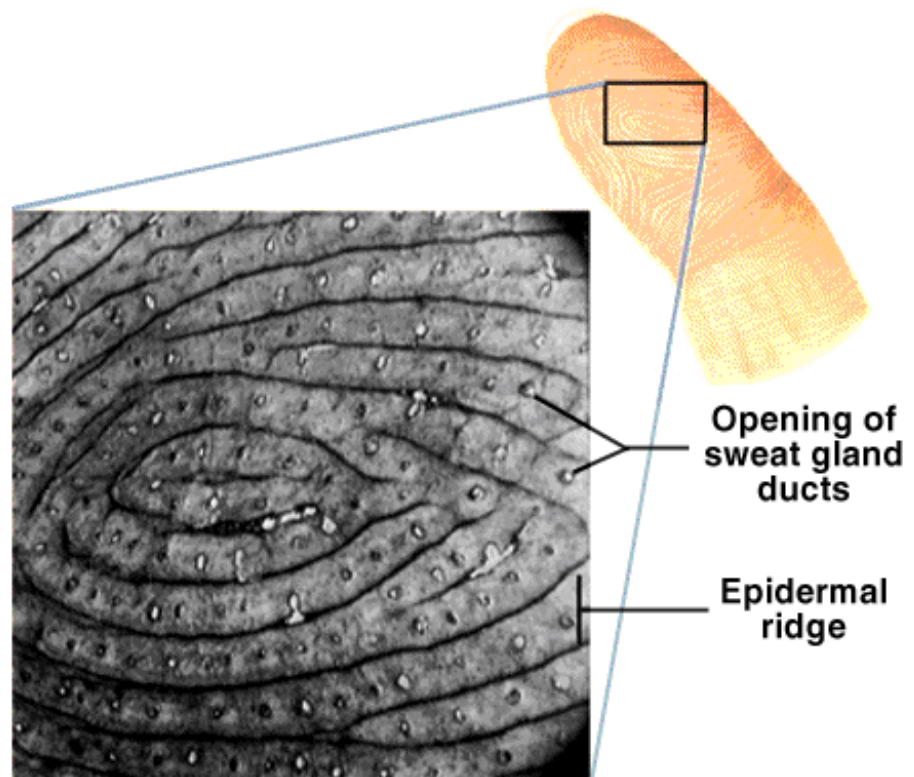


Type I Collagen

Stratum papillare 3

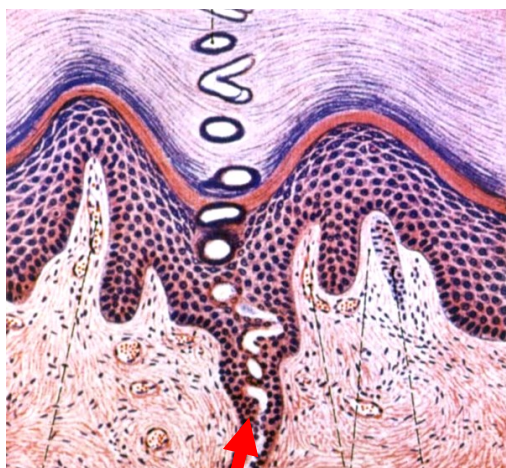
Epidermalní lišty (dlaně + plosky)

- reflect contours of the underlying dermal papillae
- form the basis for fingerprints (and footprints)
- increase firmness of grip by increasing friction
- **Daktyloskopie** - the study of the pattern of epidermal ridges

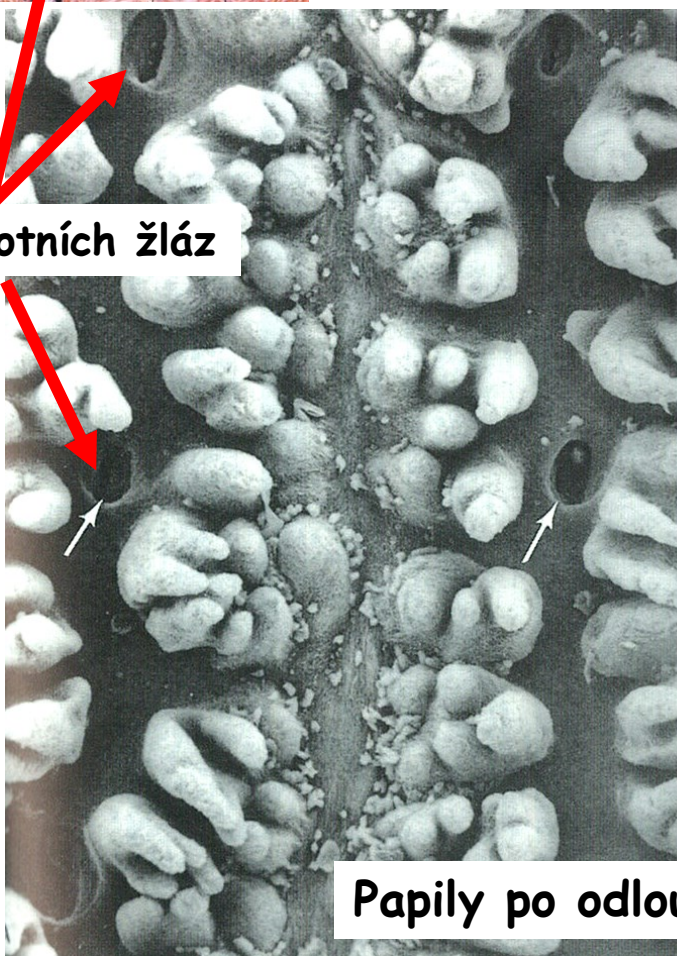


Stratum papillare 4

Epidermální lišty



Vyústění potních žláz



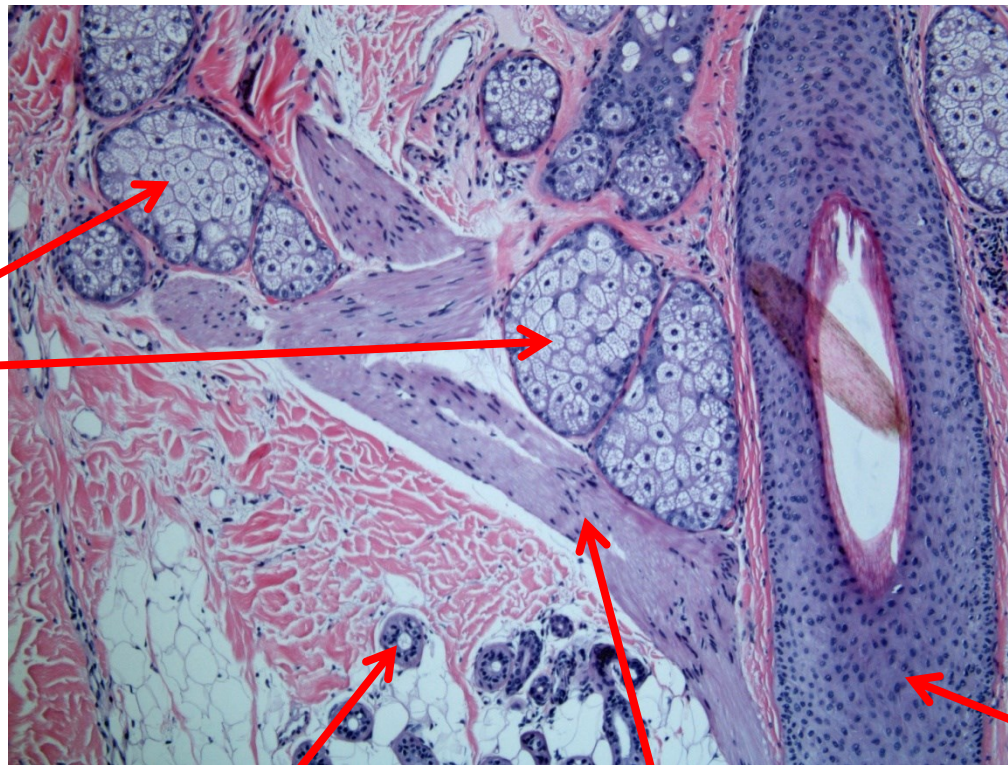
Papily po odloučení epidermis



Stratum reticulare + Kožní adnexa

- Husté nepravidelně organizované vazivo
- Mazové žlázy
- Vlasové folikuly
- Ducts of **sweat** (sudoriferous) glands
- Linie štěpnosti
- **Meissner's corpuscles** and **Pacinian corpuscles** (on lips, ext. genitalia, nipples)

Sebaceous glands



Eccrine glands

M. arrector pili

Hair follicle

Kožní žlázy

Potní	Ekrinní	Tubulózní
	Apokrinní	Tubulózní až tubuloalveolární
Mazové	Holokrinní	Větvené acinózní (alveolární)

Kožní žlázy - Ekrinní potní žlázy

(glandulae sudoriferae eccrinae)

- **Sekreční oddíl:**

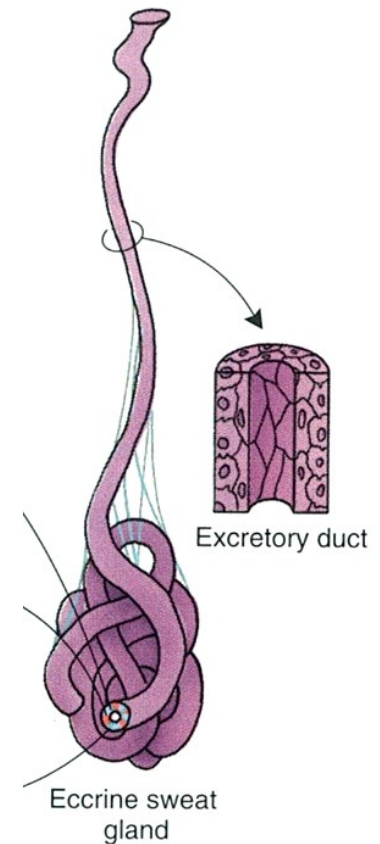
Jednovrstvý cylindrický epitel + myoepitelové buňky

- **Vývodní oddíl:**

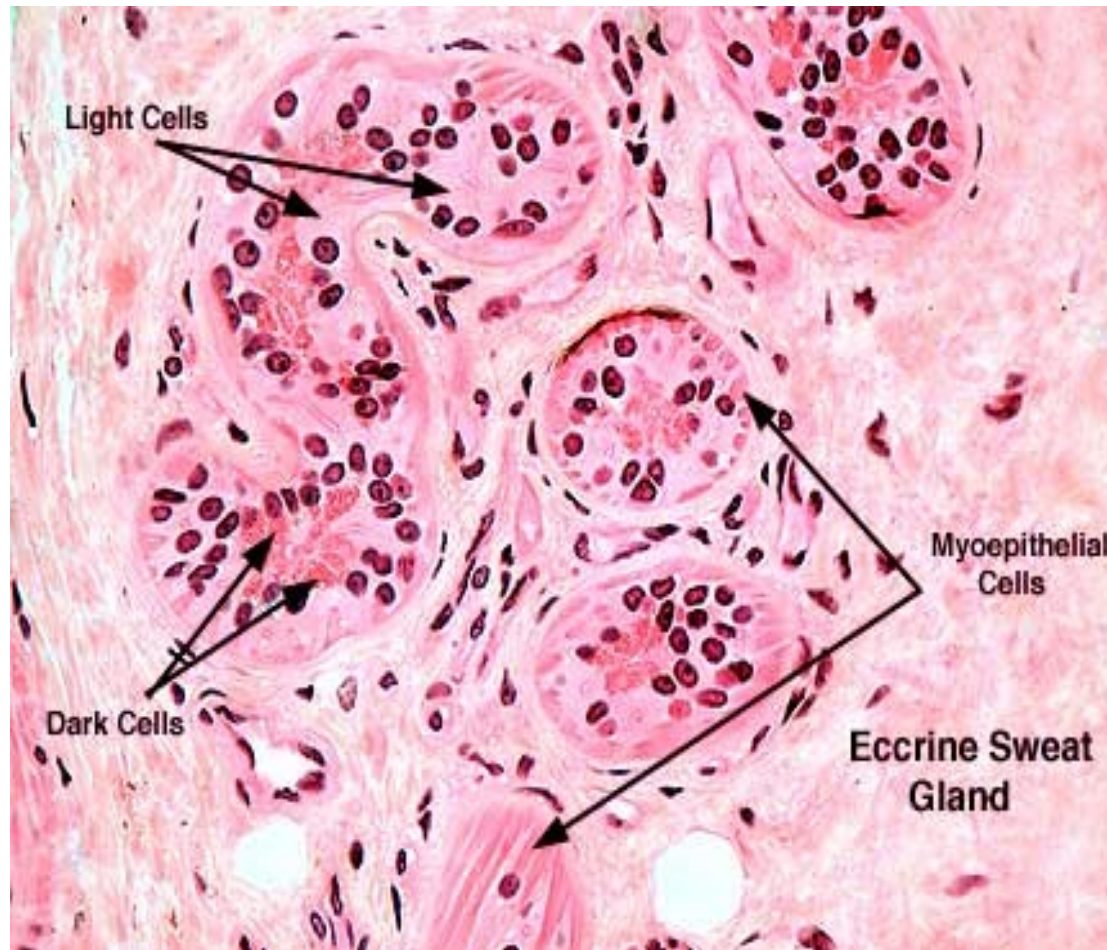
Dvouvrstvý kubický epitel

Release to adjust body temperature

Not on: red lips, glans penis, preputium, labia minora



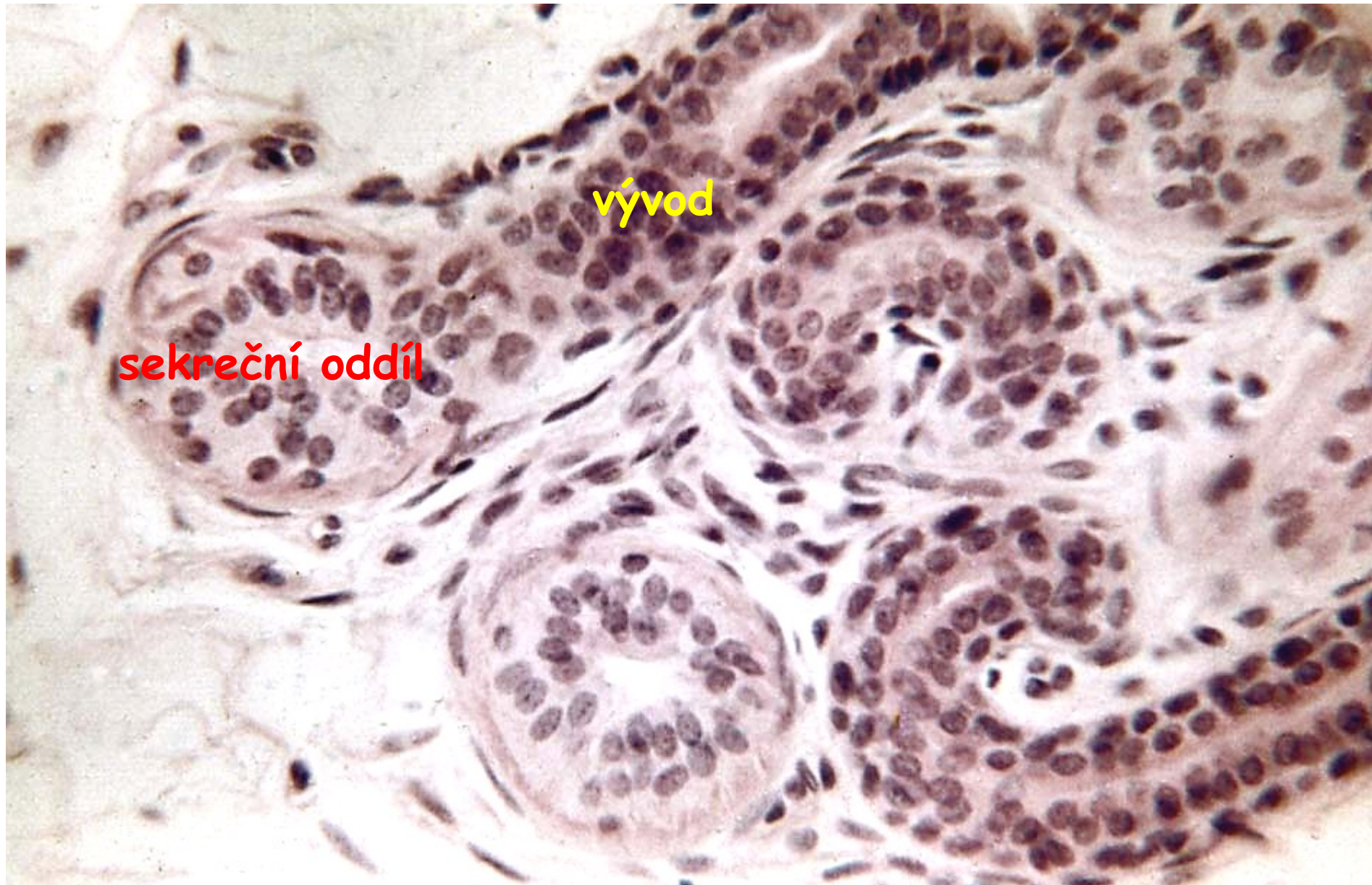
Ekrinní potní žlázy



Three cell types

- **Dark cells:** pyramid shaped with secretory granules line lumen of tubule
- **Clear cells:** located toward basement membrane - [secrete water and ions](#)
- **Myoepithelial cells:** spindle shaped contractile cells

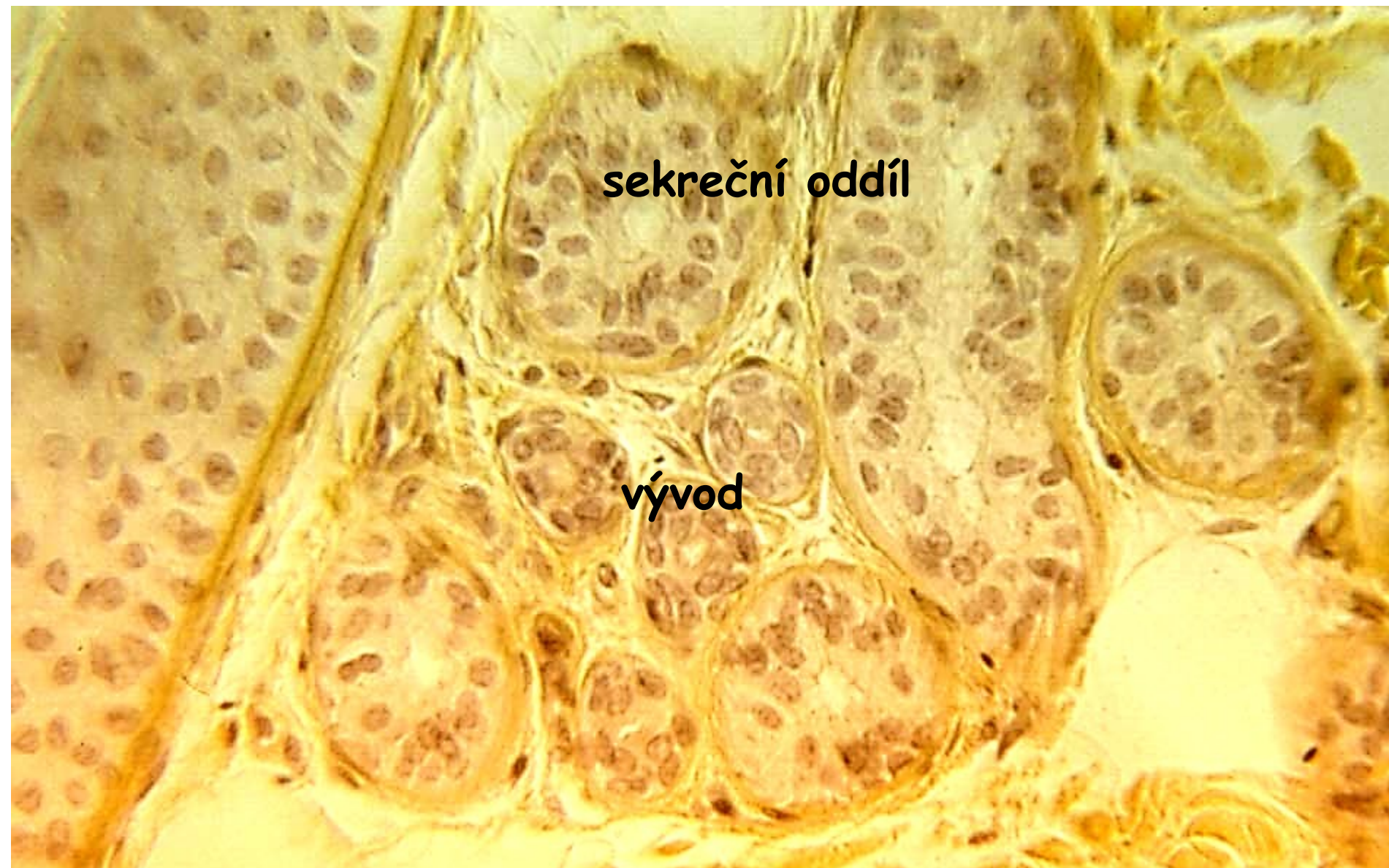
Ekrinní potní žlázy



Ekrinní potní žlázy

sekreční oddíl

vývod



Kožní žlázy - Apokrinní potní žlázy

(glandulae sudoriferae apocrinae)

- **Sekreční oddíl:**

Jednovrstvý dlaždicový až cylindrický epitel
(v závislosti na obsahu produktu) + myoepitelové buňky

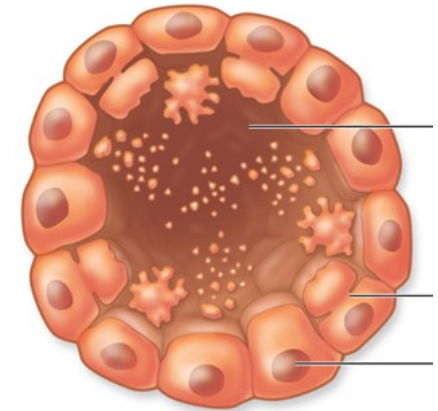
- **Vývodní oddíl:**

Dvouvrstvý kubický epitel

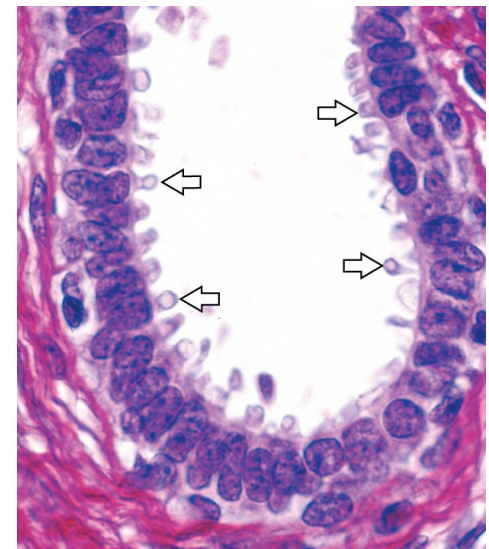
Vždy asociovány s vlasovým folikulem !!!

Řízeny hormonálně (aromatické žlázy)

Pouze na: podpaždí, dvorec prsu, scrotum,
labia maiora, perianální oblast, zevní
zvukod, eye lid (*Mollovy žlázy*)



c Apocrine gland

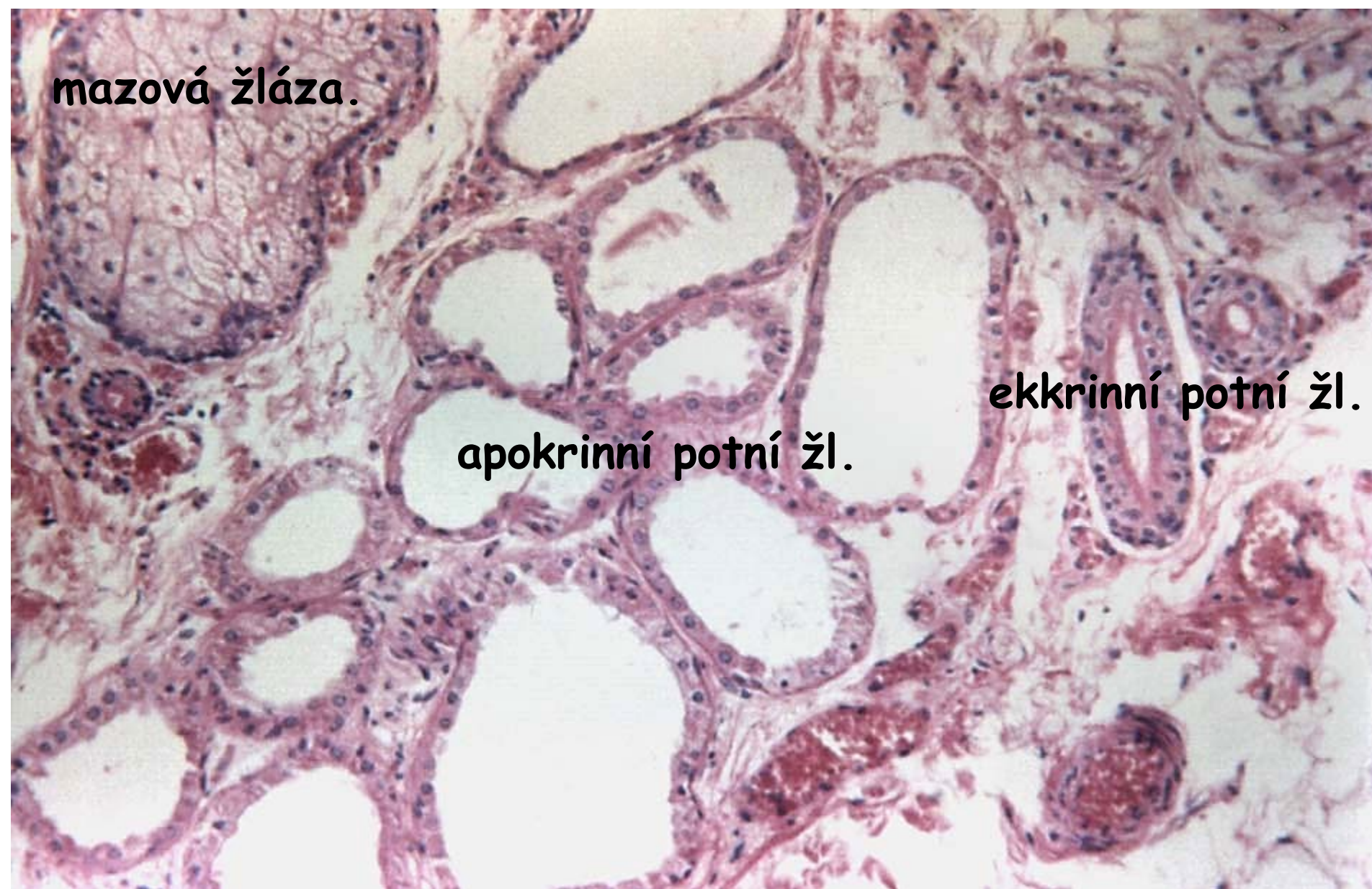


Apokrinní potní žlázy

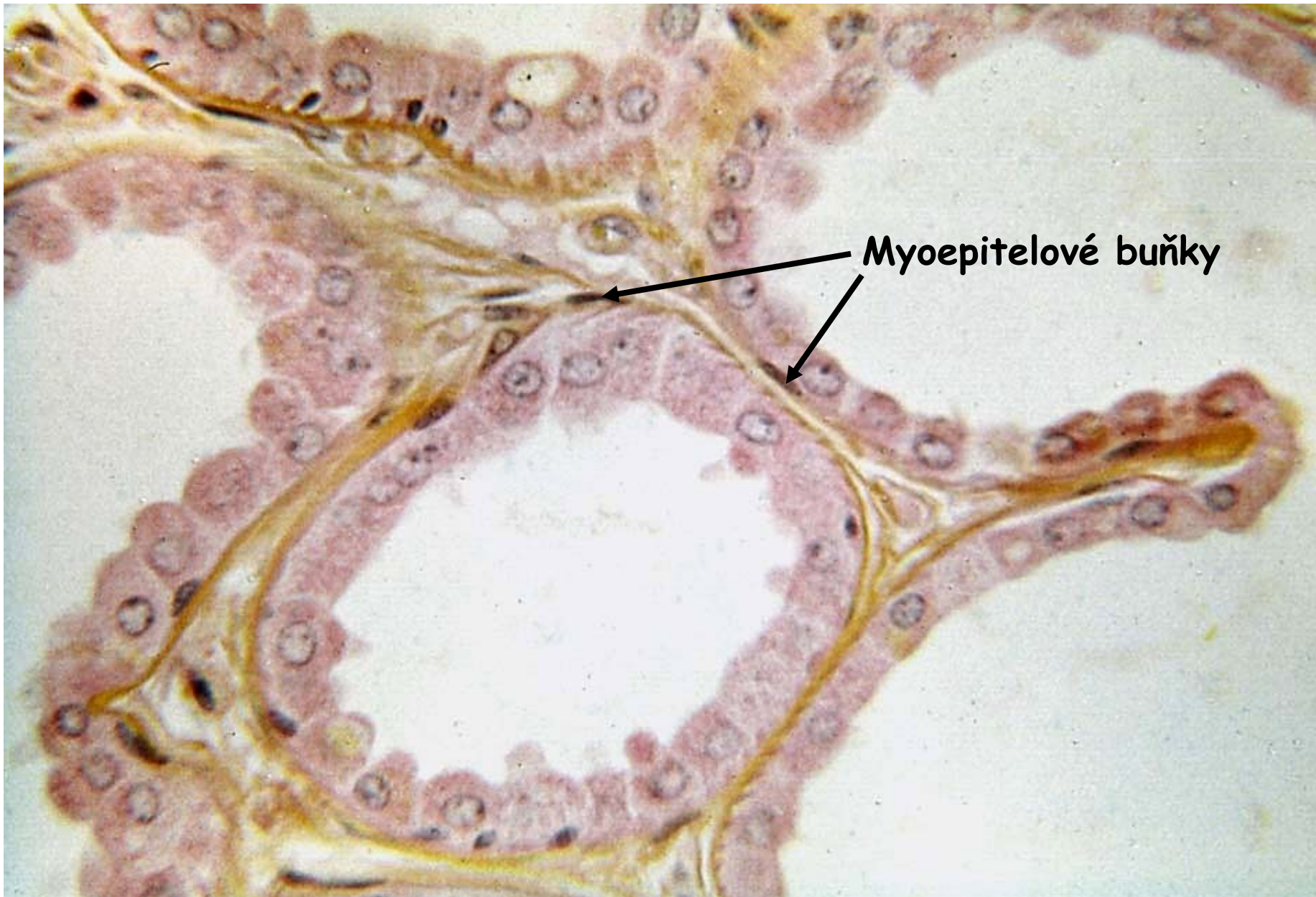
mazová žláza.

ekkrinní potní žl.

apokrinní potní žl.



Apokrinní potní žlázy



Kožní žlázy - Mazové žlázy

(glandulae sebaceae)

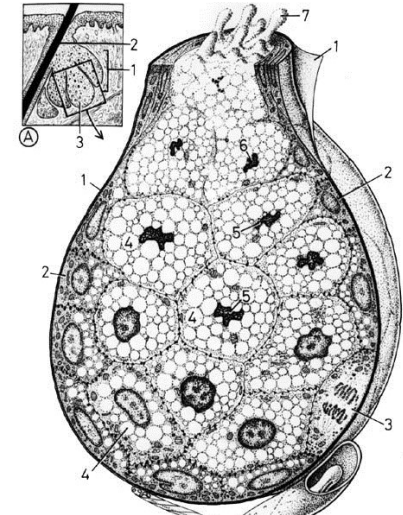
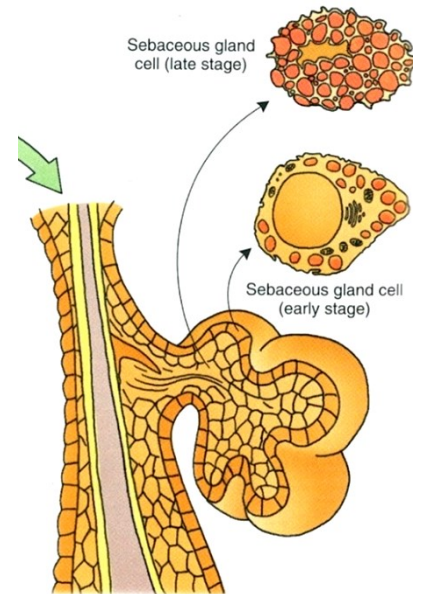
Jendoduché větvené acinární žlázy
Několik acinů ústí do jednoho vývodu.

- **Sekreční oddíl:**
Vícevrstvý epitel, postupně degeneruje
- **Vývodní oddíl:**
Vícevrstvý dlaždicový epitel

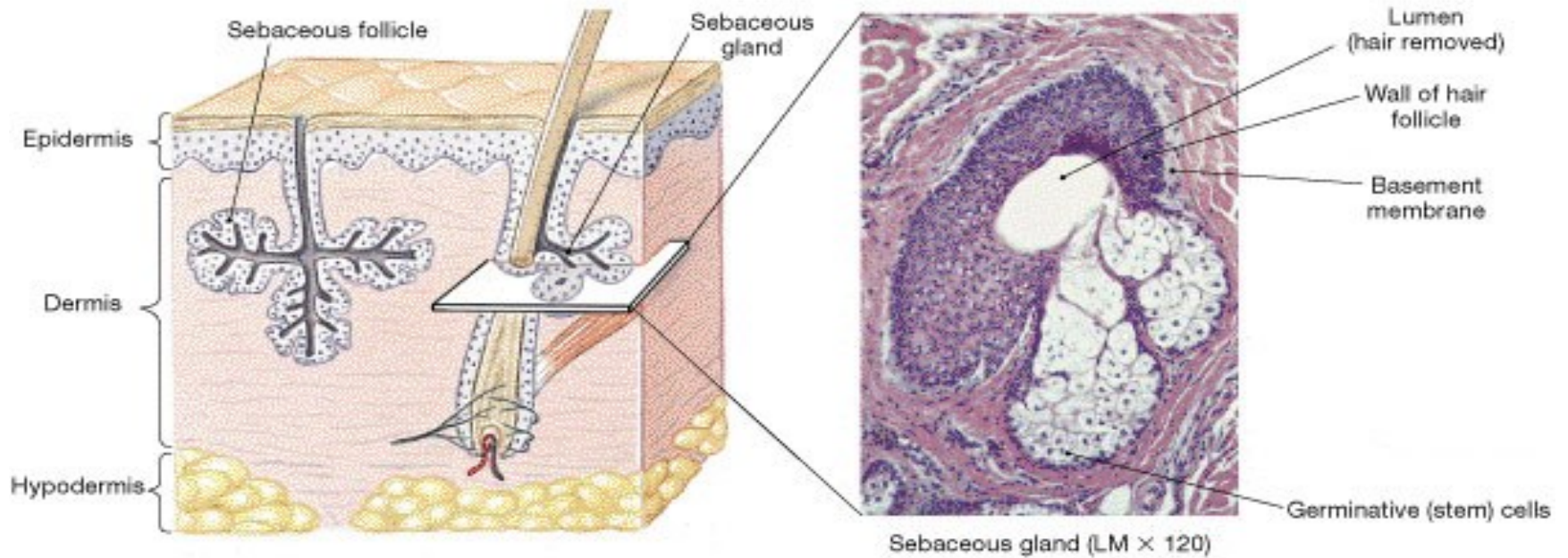
Obvykle asociovány s vlasovým folikulem

Volně: červeň rtů, glans penis, preputium, labia minora, oční víčko (*Meibomovy žlázy*)

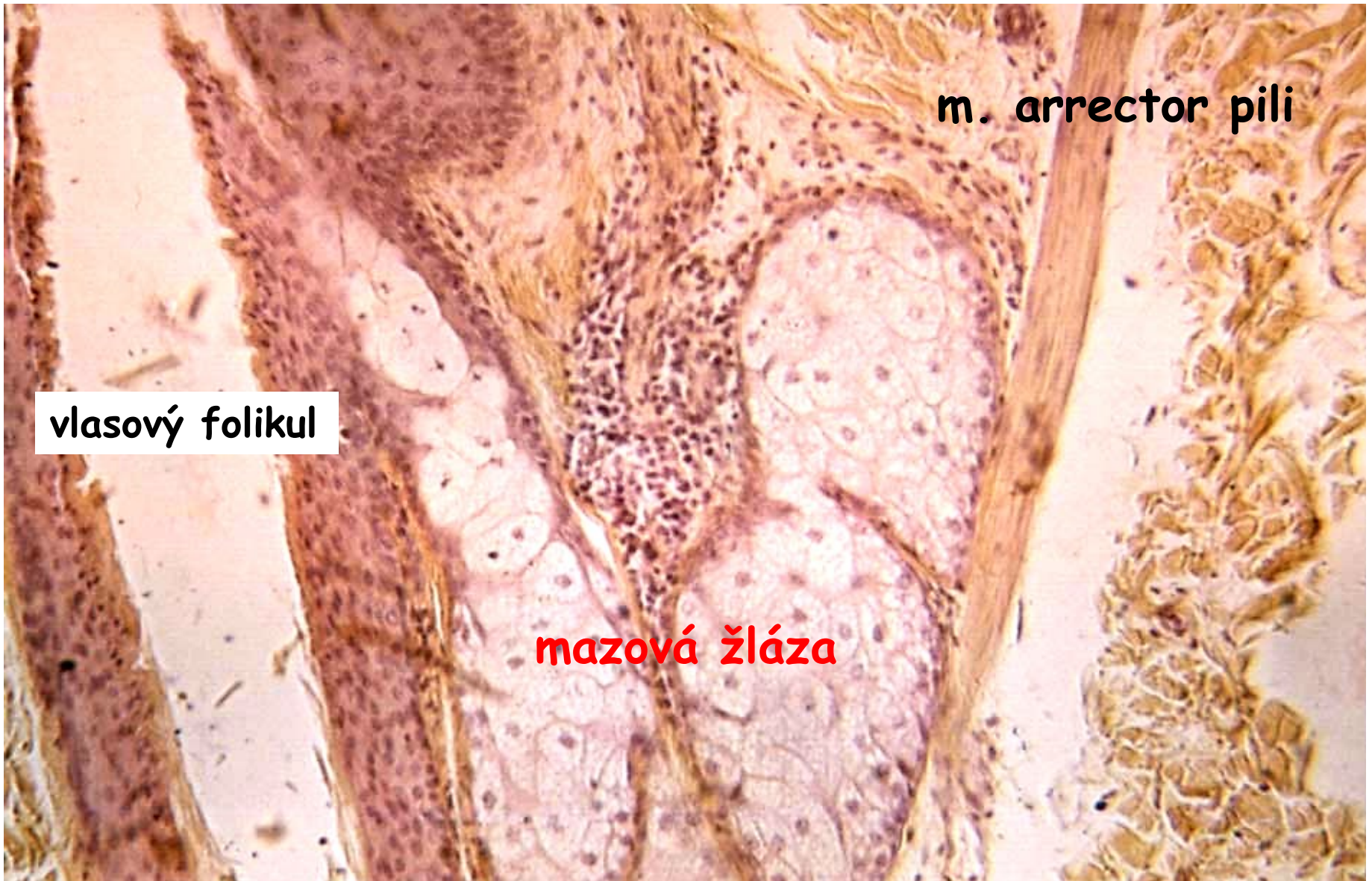
Nejsou na: dlaních a ploskách nohy



Mazové žlázy



Mazové žlázy

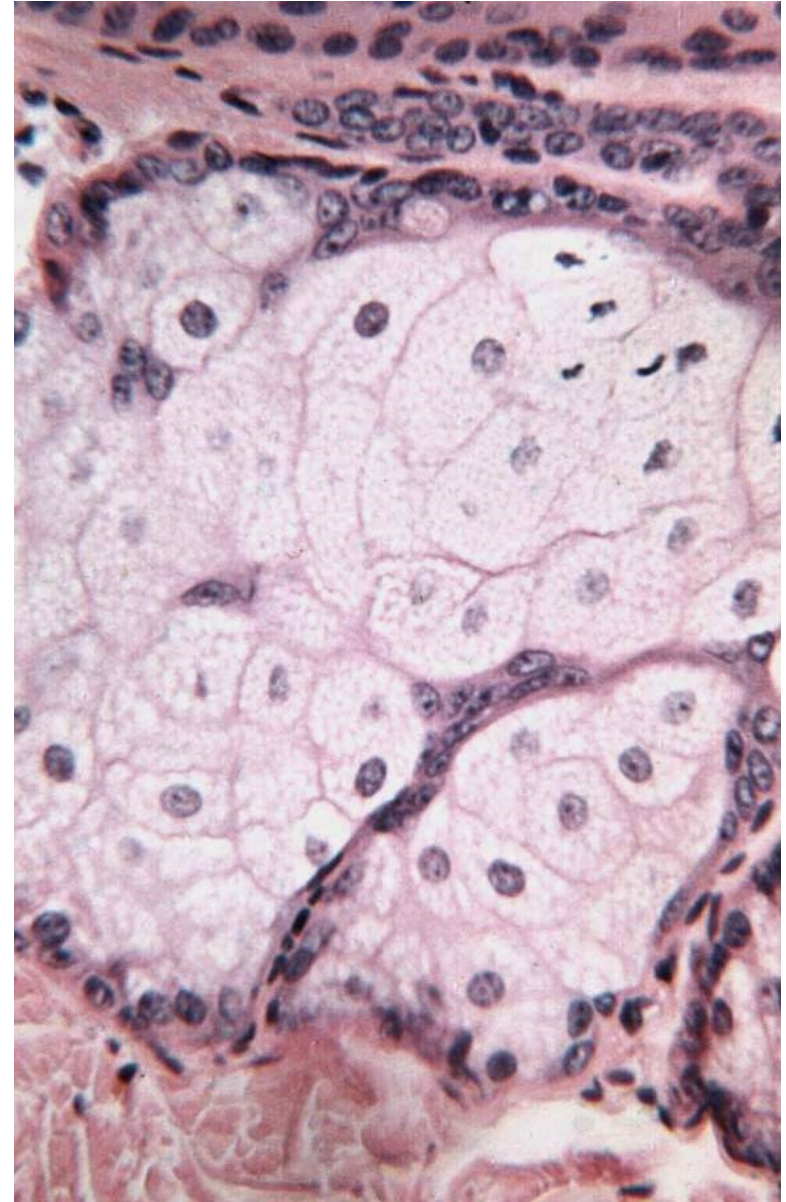
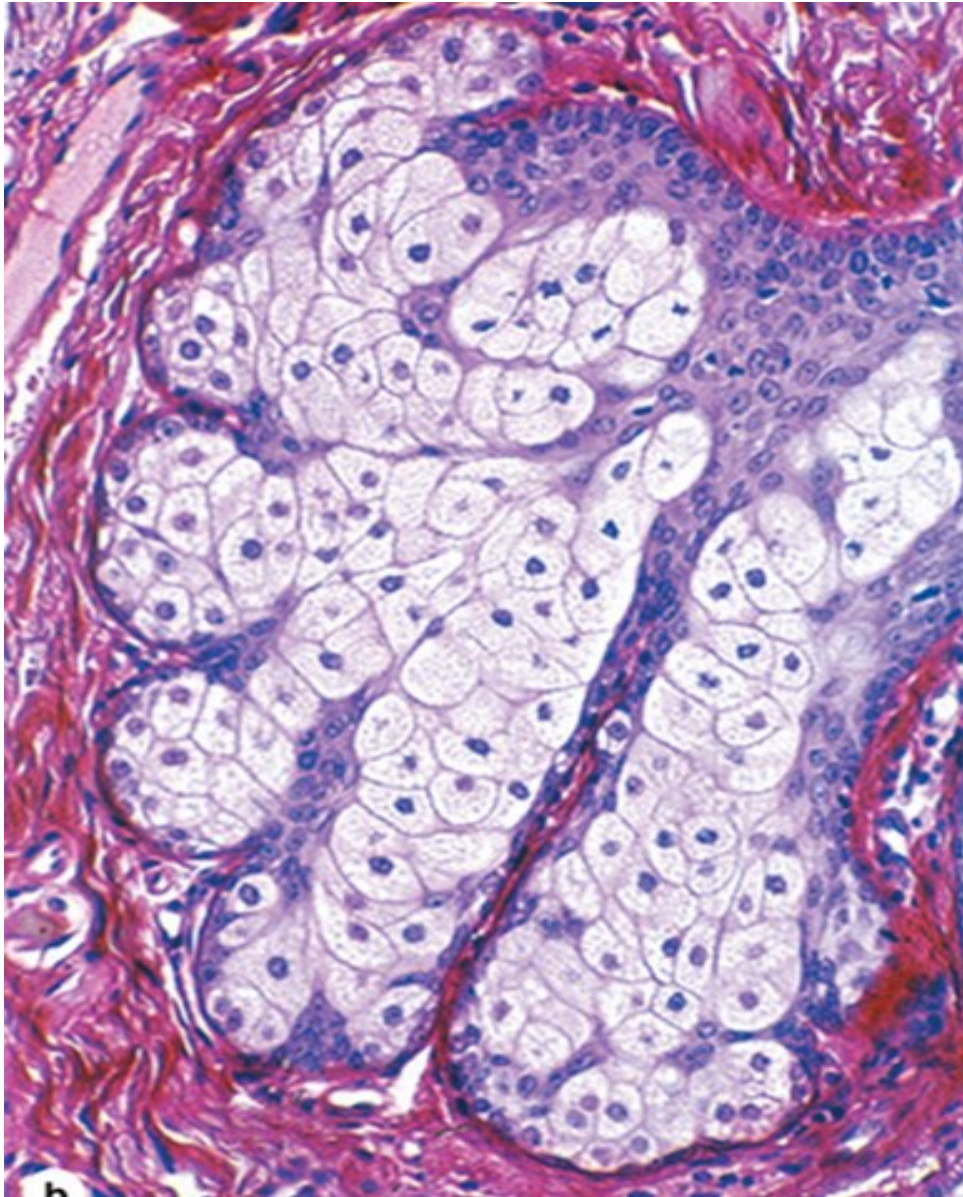


vlasový folikul

mazová žláza

m. arrector pili

Mazové žlázy



Mléčná žláza

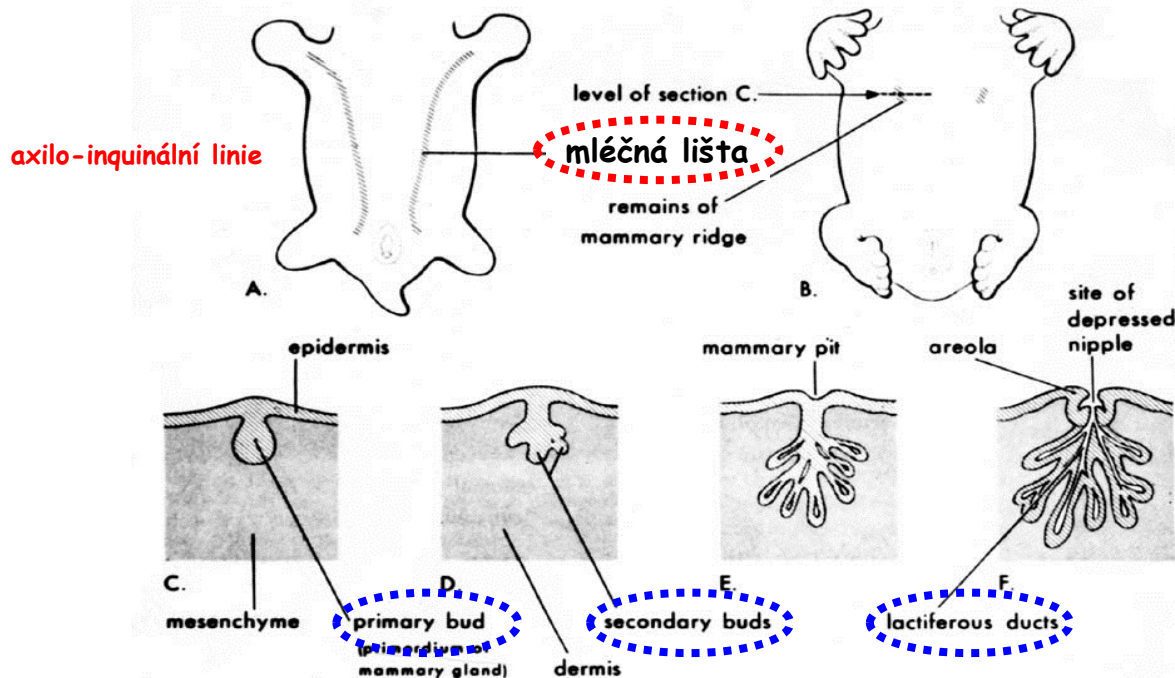
Modifikovaná a specializovaná tuboalveolární potní žláza.

Parenchym

- Vývody
- Ektoderm povrchu těla (od šestého týdne)

Stroma

- Pojivová tkáň
- Mezenchymový původ



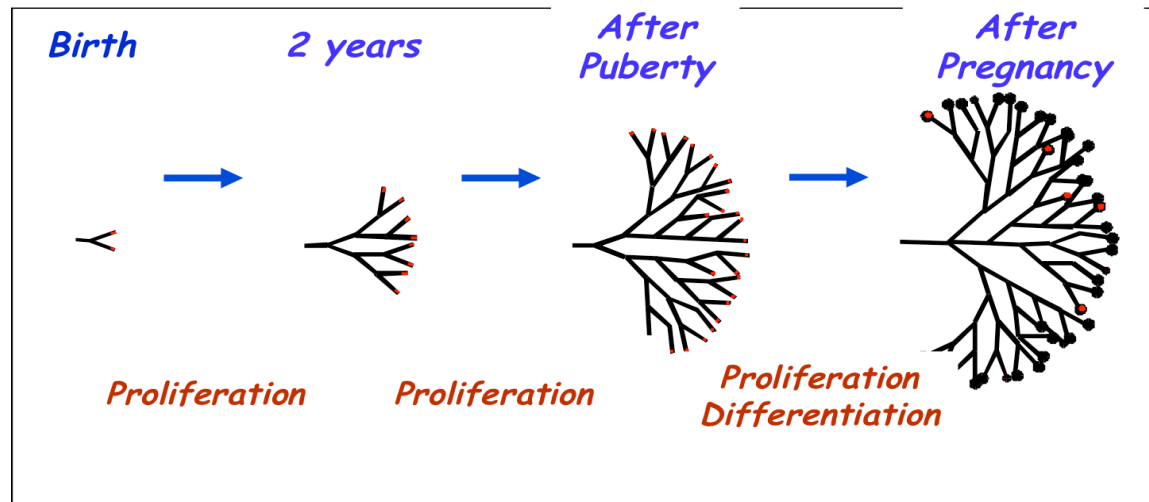
Nadpočetné mléčné žlázy a bradavky

- An extra breast (**polymastia**) or nipple (**polythelia**) occurs in approximately 1% of the female population - inheritable.
- **Supernumerary nipples** are also relatively common in **males**.
- Less commonly, **supernumerary breasts or nipples** appear in the axillary or abdominal regions of females developing from extra mammary buds that develop along the mammary crests. They become more obvious in women when pregnancy occurs.



Vývoj duktálního stromu mléčné žlázy

Odehrává se hlavně až po narození

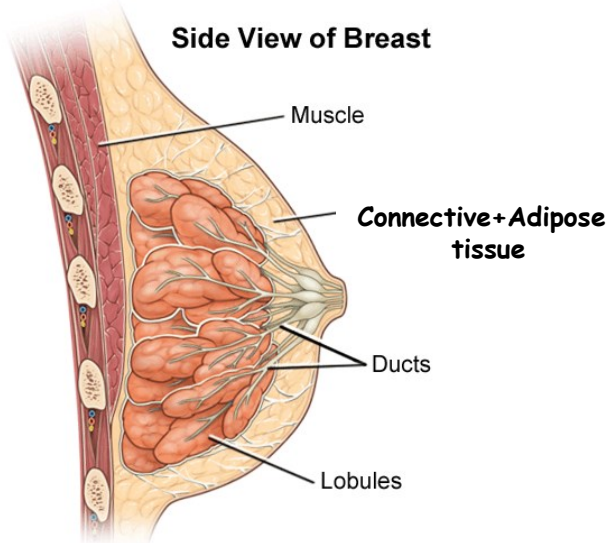


At **puberty** changes in the hormonal secretions in females cause further development and structural changes within the glands.

Secretions of **estrogen and progesterone** from the ovaries (and later from the placenta) and **prolactin** from the acidophils of the anterior pituitary gland initiate development of **lobules and terminal ductules**.

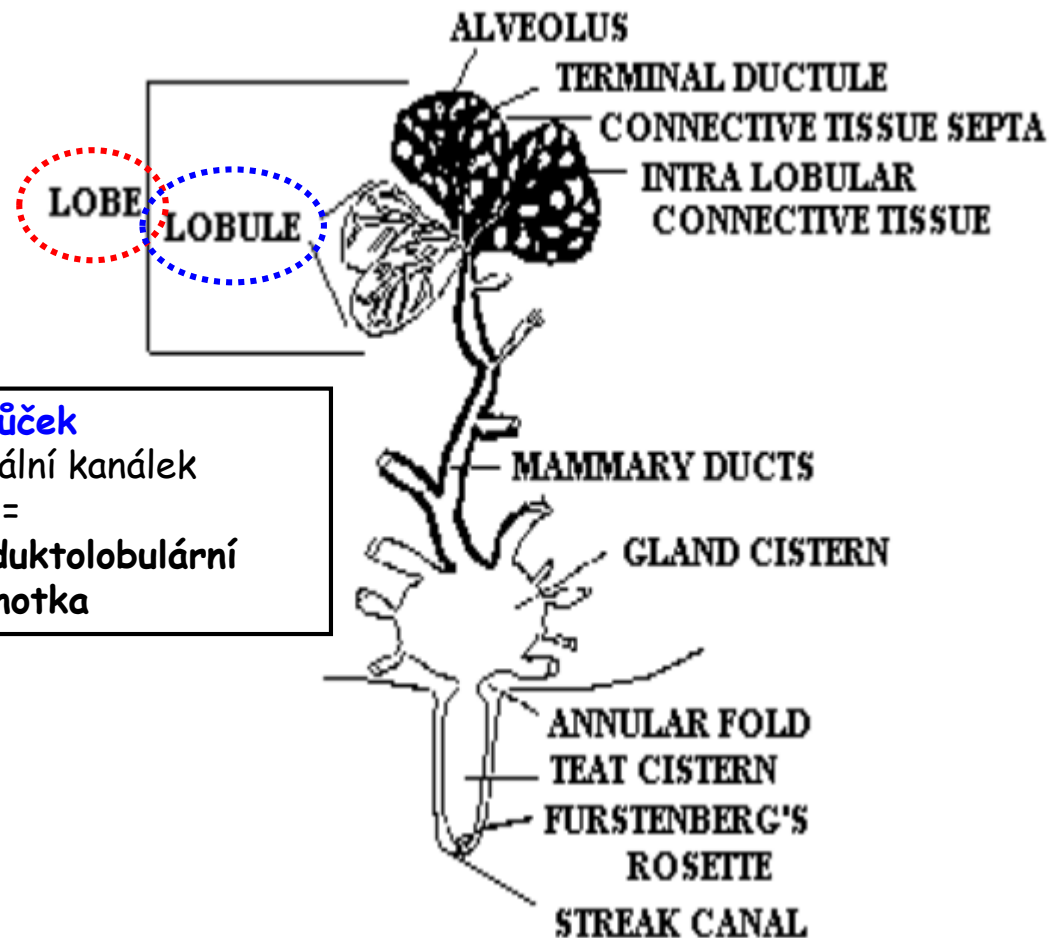
Full development of the ductal portion of the breast requires **glucocorticoids** and further activation by **somatotropin**.

mléčná žláza - Anatomická organizace



Lalok = 1 žláza

- total of 15 to 20 lobes
- 1 lalok - 1 hlavní vývod (ductus lactiferi)



Lalůček

+ 1 terminální kanálek

=

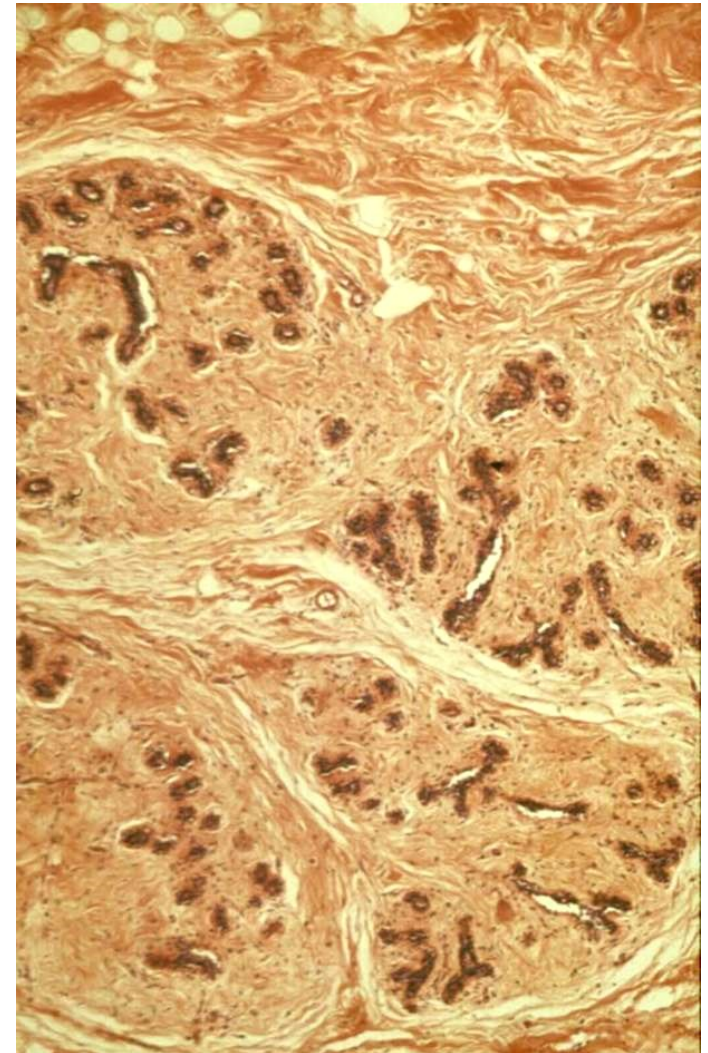
Terminální duktolobulární jednotka

Radial organization

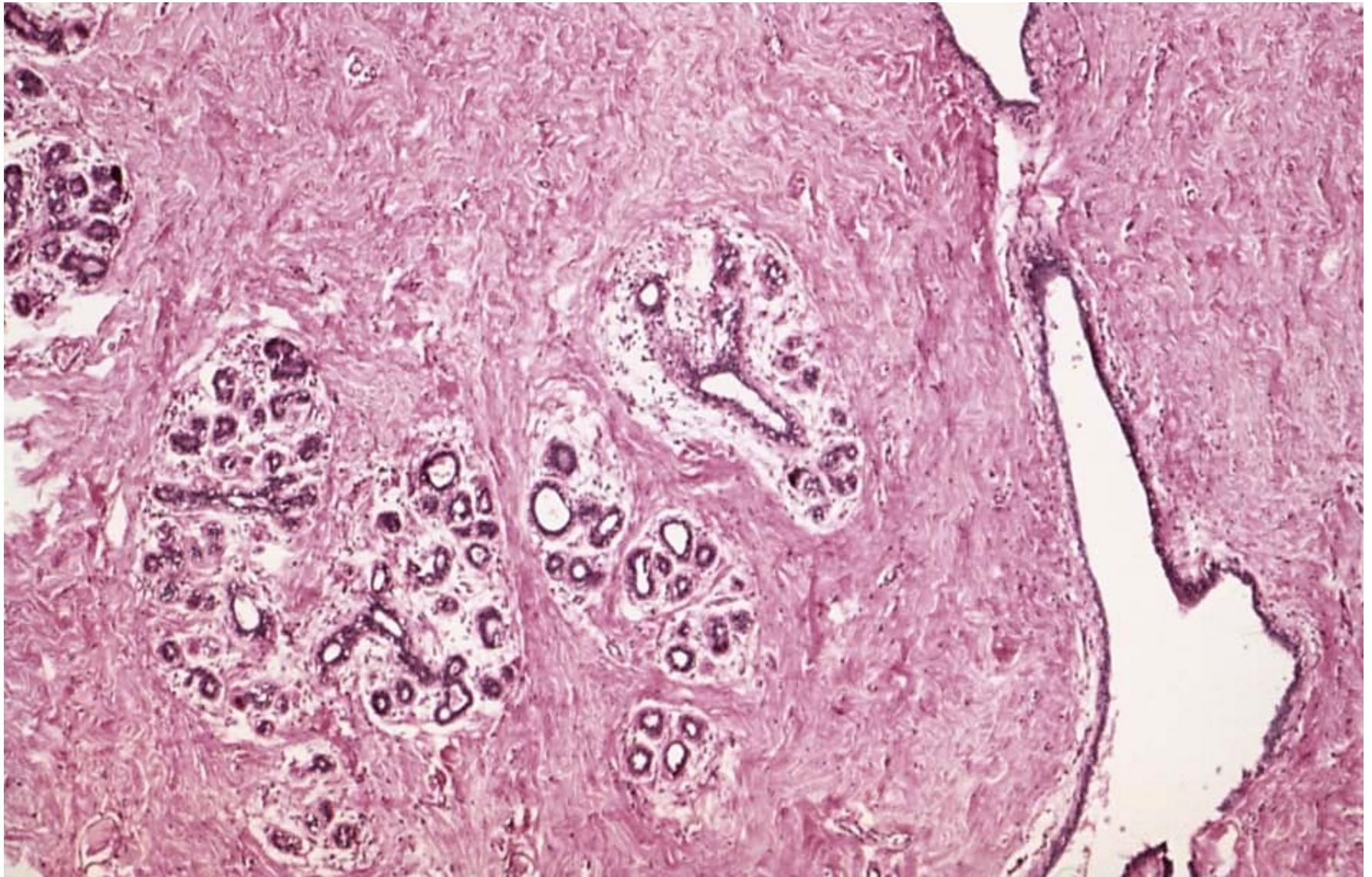


Mléčná žláza - Po pubertě - Nelaktující 1

- majority = connective tissue
- the same basic architecture as the lactating (active) mammary gland
- **Sekreční oddíly** - alveoli are not developed, only small groups of cells at the endings of ductuli
- **Vývody** - branched + partly luminized

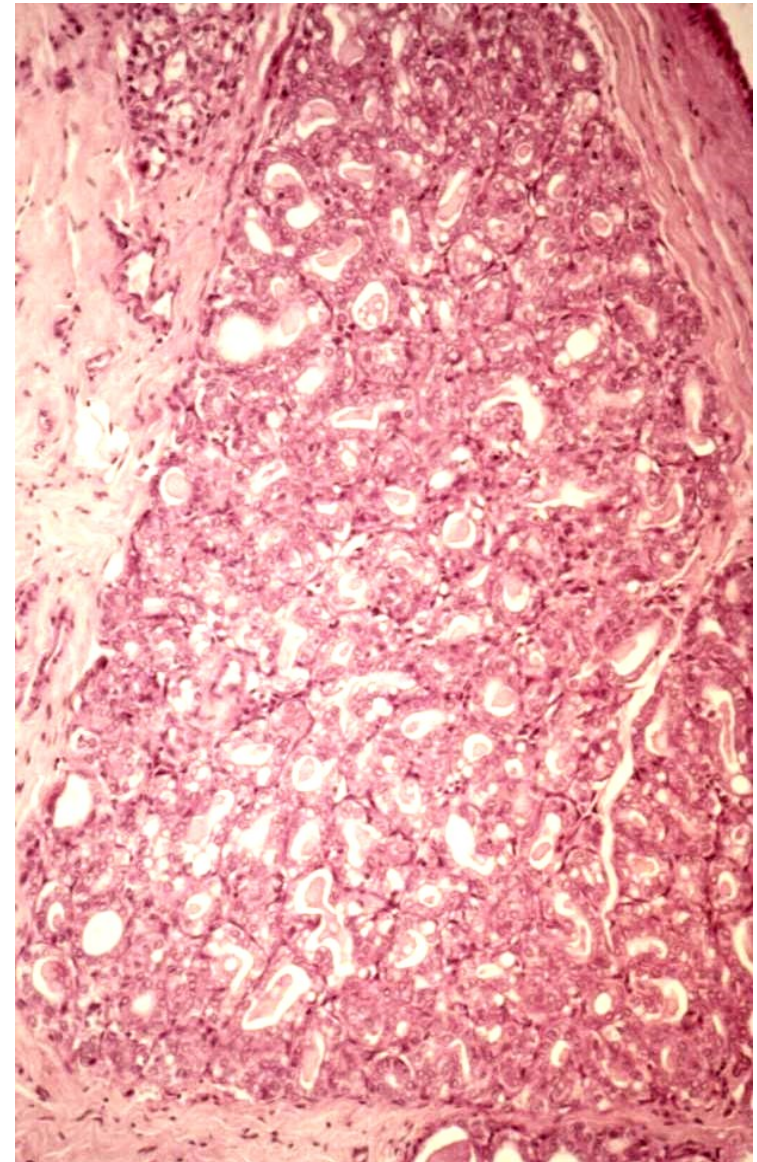
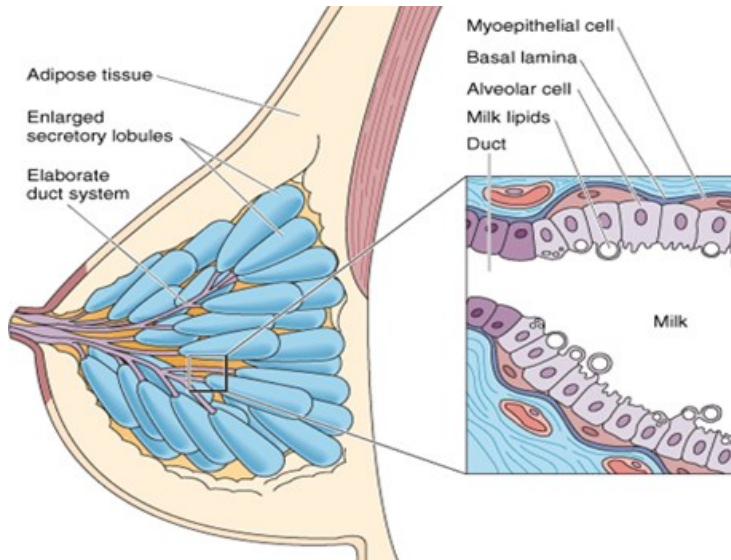


Mléčná žláza - Po pubertě - Nelaktující 2



Mléčná žláza - Laktující 1

- majority = glands
- **Vývodní oddíly:** proliferate, branch, luminize (estrogens)
- **Sekreční alveoly:** proliferation, luminization (progesterone, prolactin)
- connective tissue - only thin septa



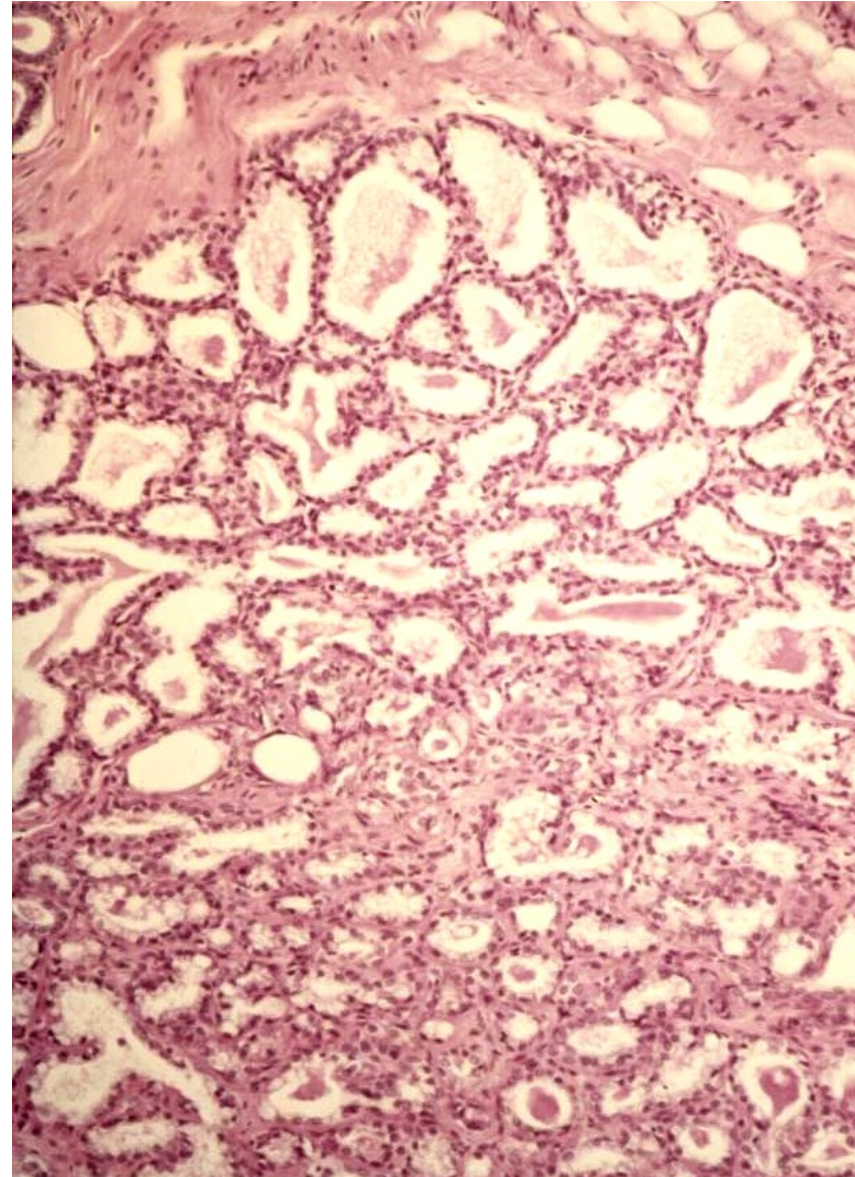
Mléčná žláza - Laktující 2

- **Sekreční oddíly:** filled by secretion (lipid droplets = apocrine, proteins = eccrine - exocytosis)
- **Vývodní oddíly:**

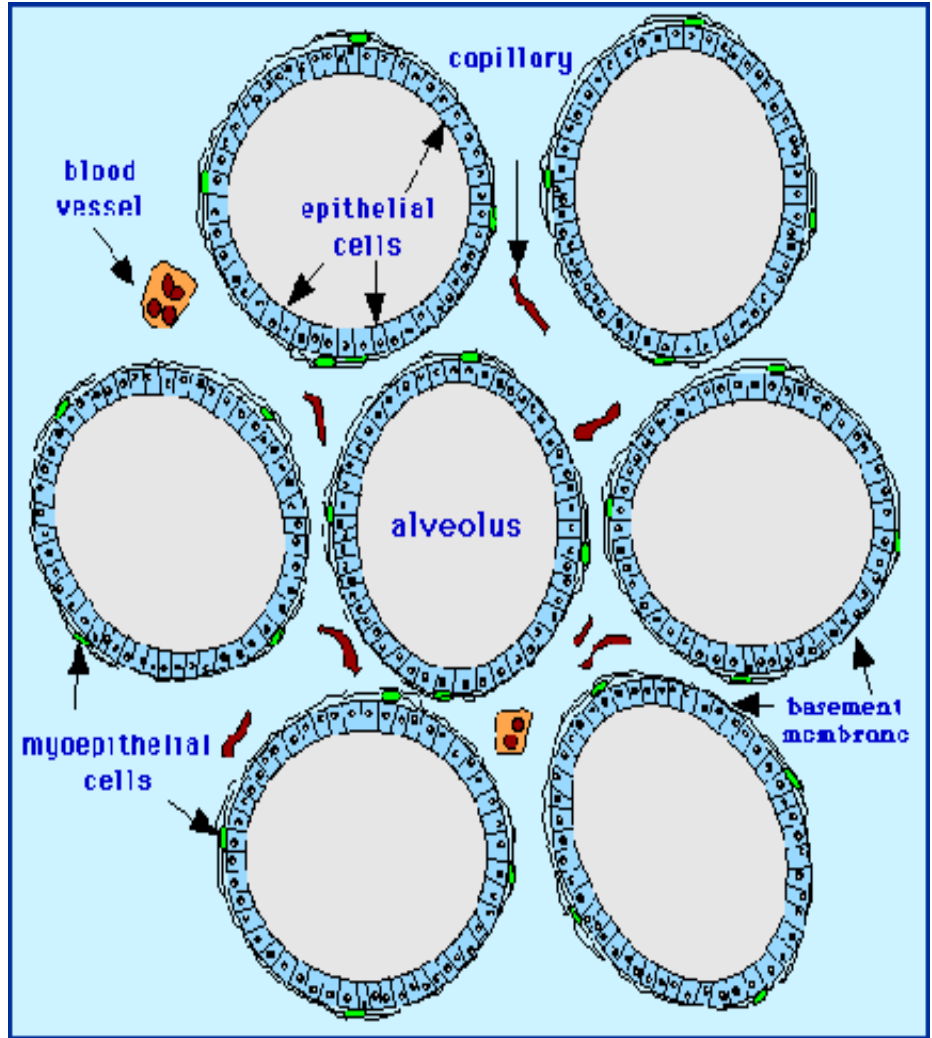
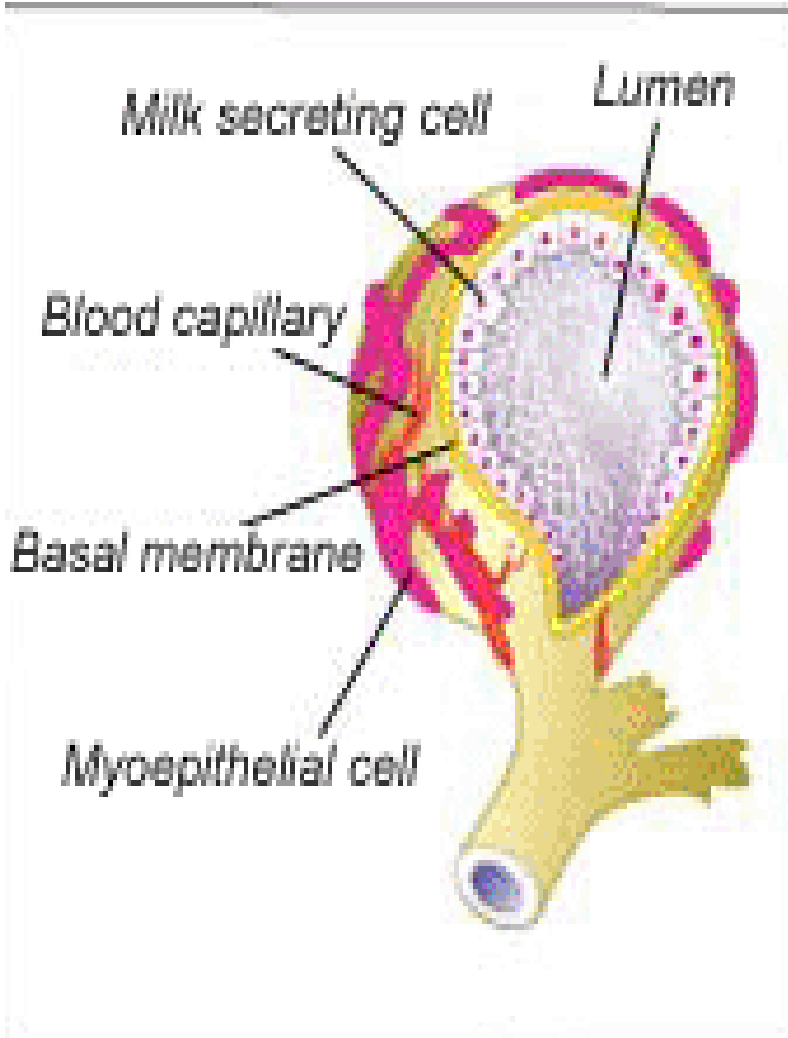
Kanálky v bradavce: vrstevnatý dlaždicový keratinizující ep.

Sinus lactifer a ductus lactiferi: jednovrstvý/vrstevnatý kubický/cylindrický epitel

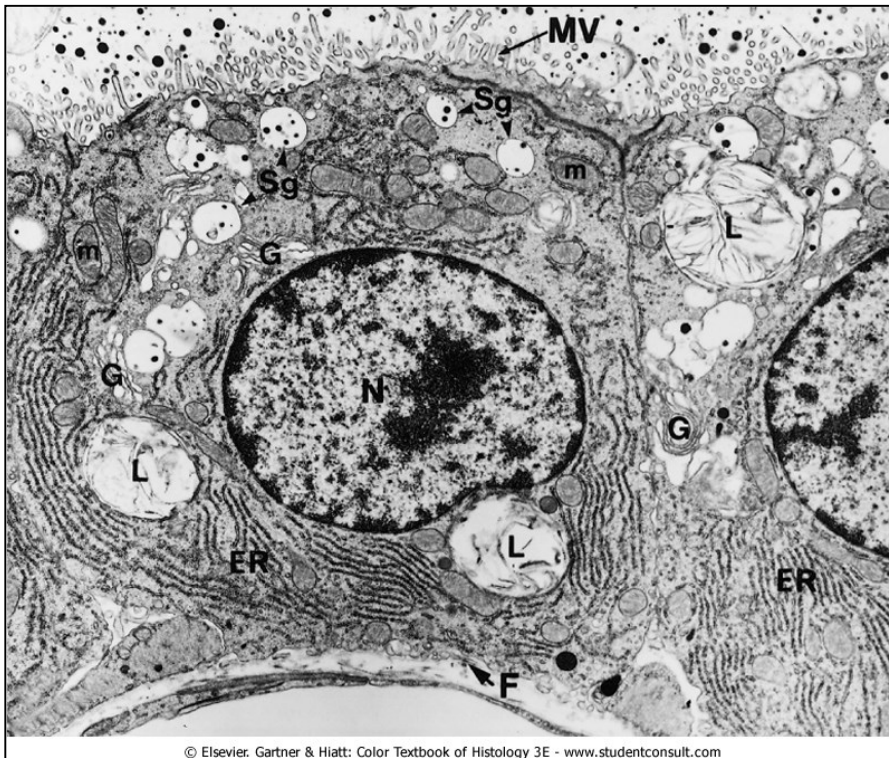
Terminální kanálky: jednovrstvý kubický ep. + myoepitelové buňky



Mléčná žláza - Laktující 3



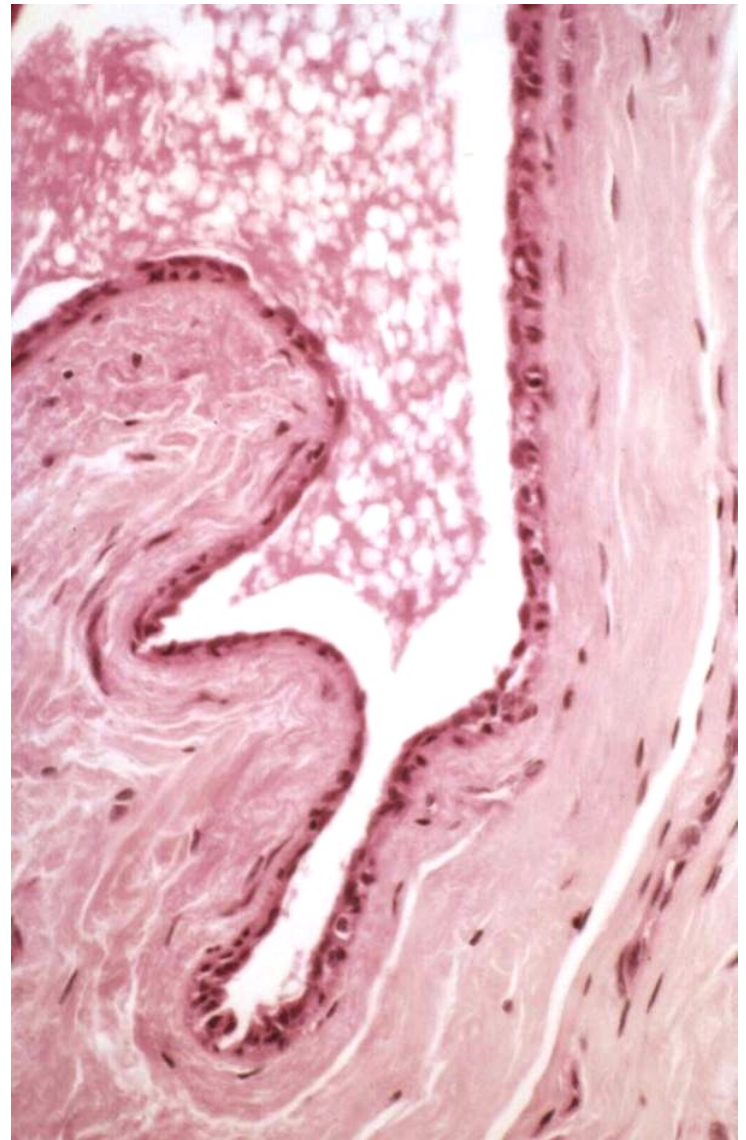
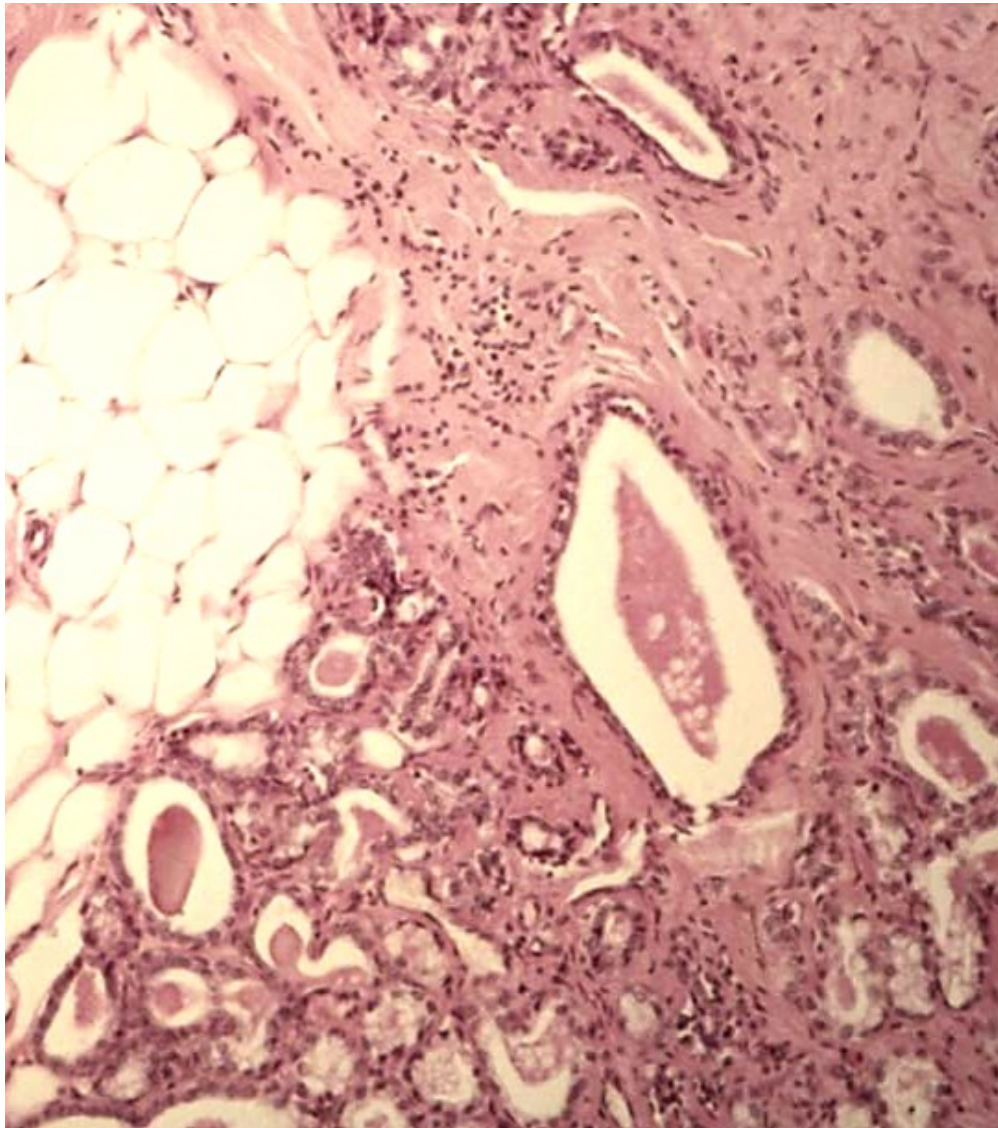
Mléčná žláza - Laktující 4



Electron micrograph of an acinar cell

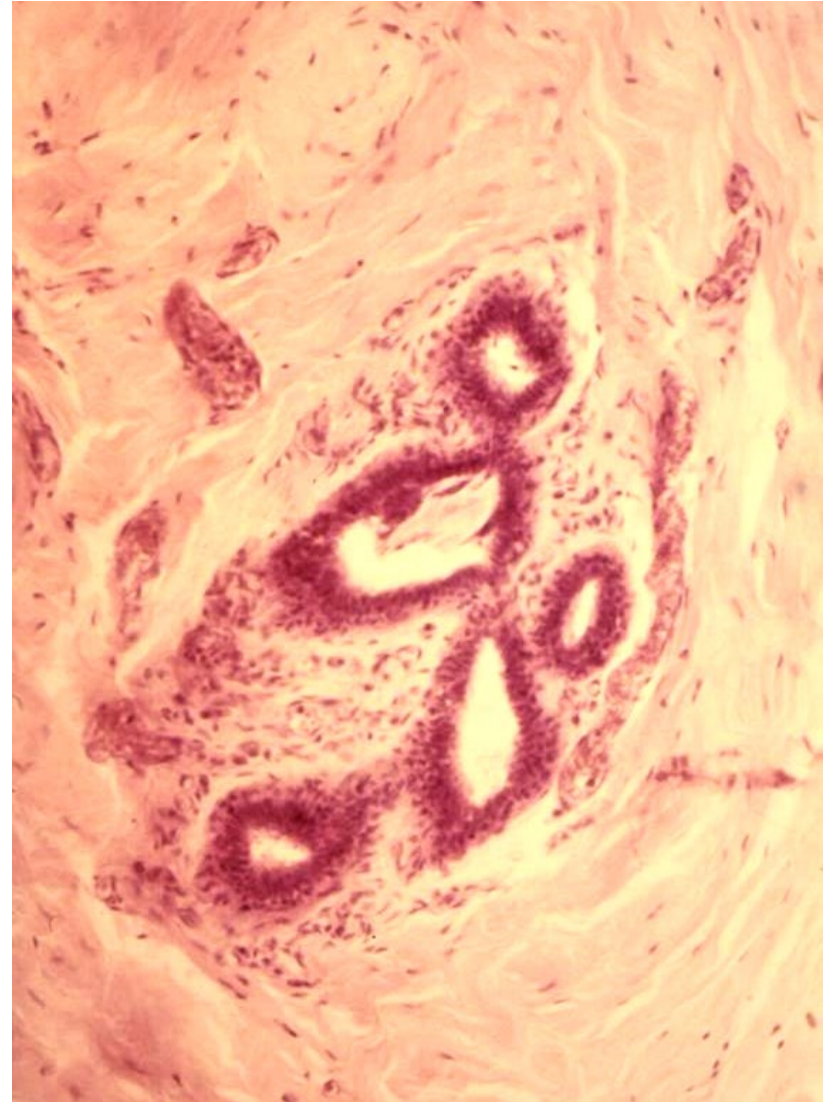
- The **alveoli** are composed of **cuboidal cells** partially surrounded by a meshwork of **myoepithelial cells**.
- These secretory cells possess **abundant RER** and **mitochondria**, several Golgi complexes, many **lipid droplets**, and numerous vesicles containing **caseins** (milk proteins) and **lactose**.
- **Not all regions of the alveolus are in the same stage of production**, because different acini display varying degrees of preparation for synthesis of milk substances.

Mléčná žláza - Laktující 6

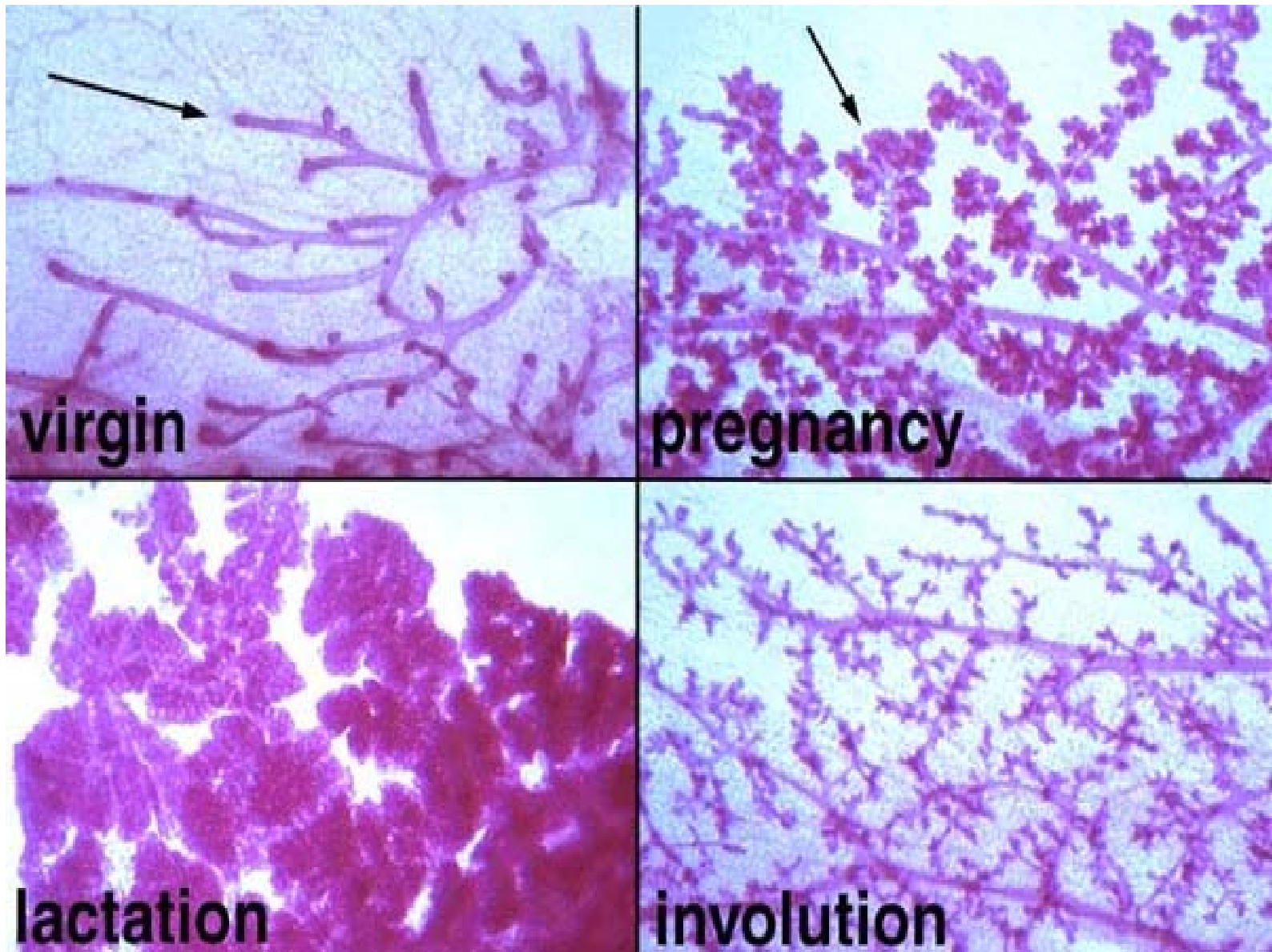


Mléčná žláza - Involute

- atrophy and degeneration of the secretory cells
- milk biosynthesis ceases
- adipose cells occupy the empty space
- the duct system remains
- this process continues throughout menopause



Mléčná žláza - Stadia vývoje (funkce)



Vlas - Všeobecná stavba

Stvol: portion of hair above surface

Kořen: portion of hair below surface

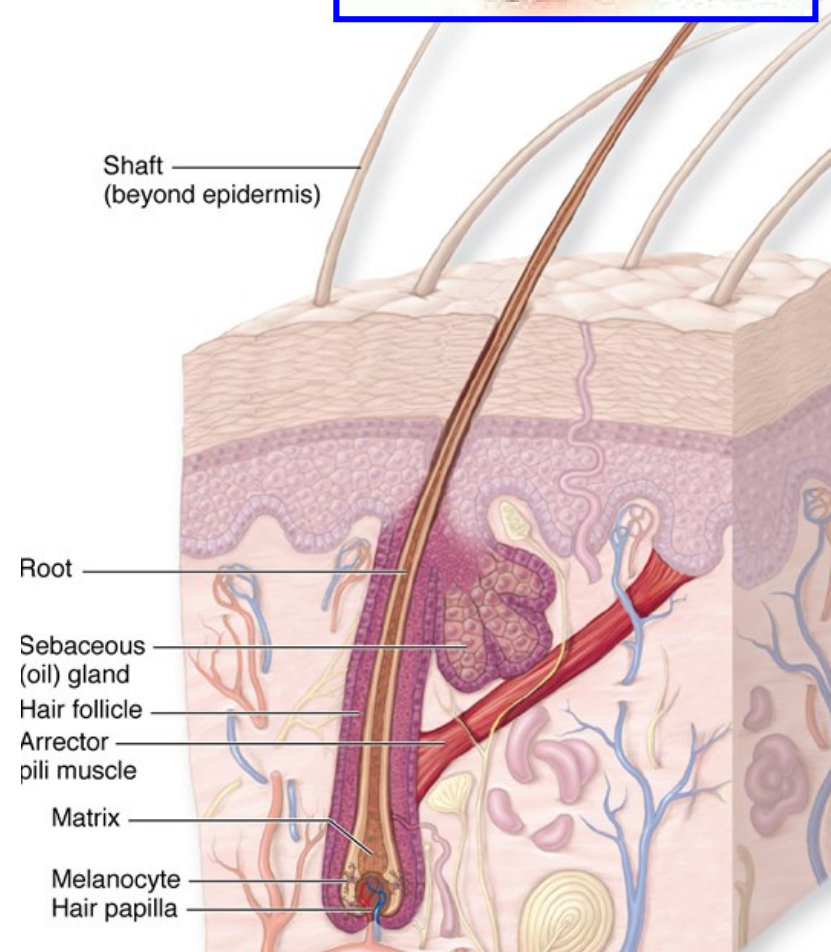
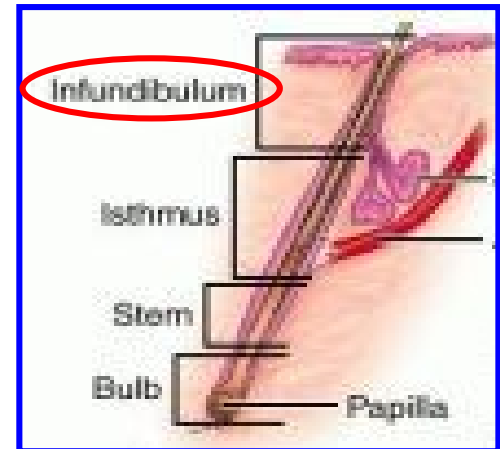
Kutikula: outermost layer of hair

Vlasový folikul: invagination of epidermis (to dermis / hypodermis)

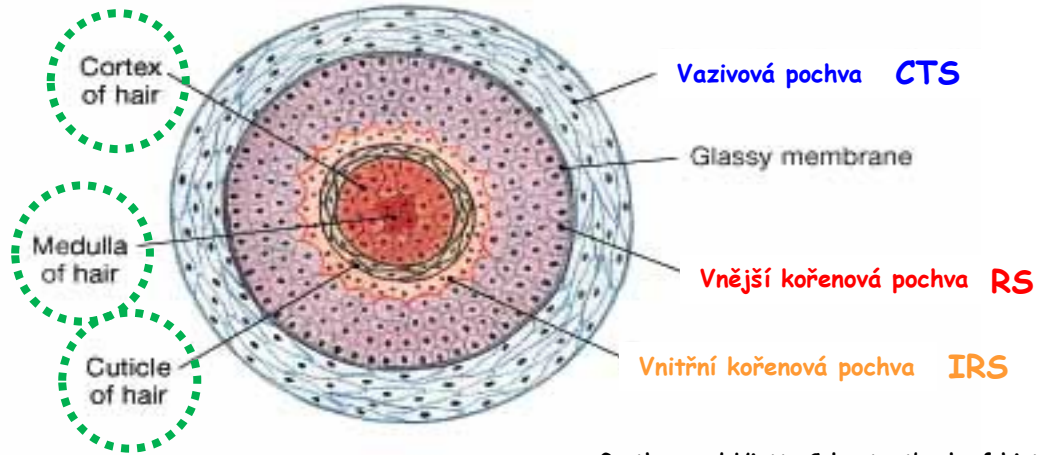
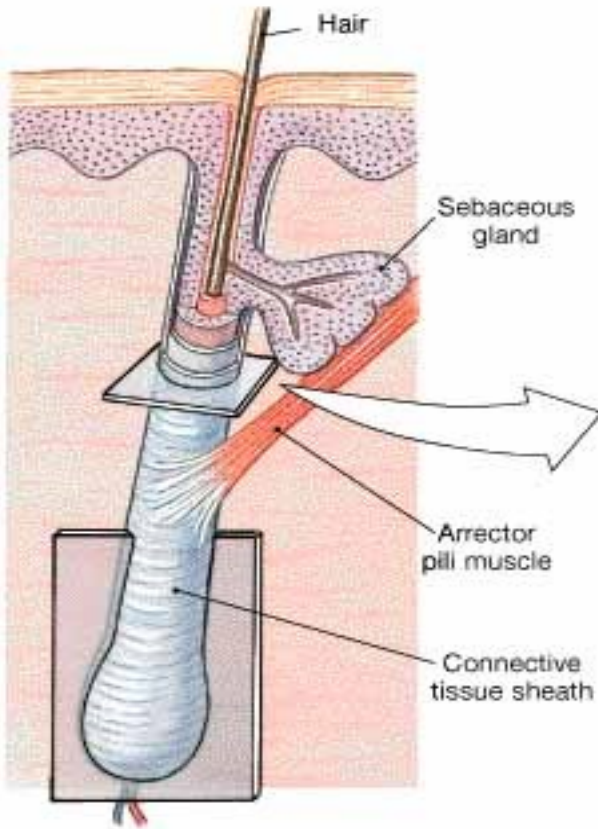
Vlasová cibulka: at the base of the follicle (matrix - epithelial cells + melanocytes)

Vlasová papila: projection of dermal connective tissue into bulb - contains blood vessels and nerves

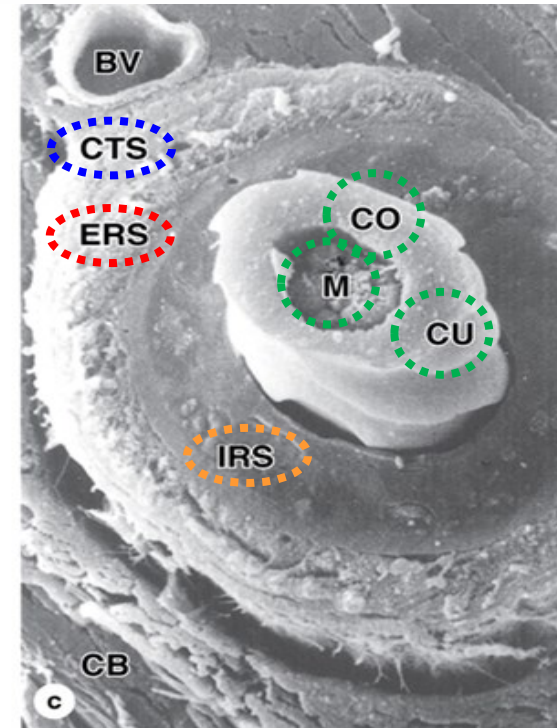
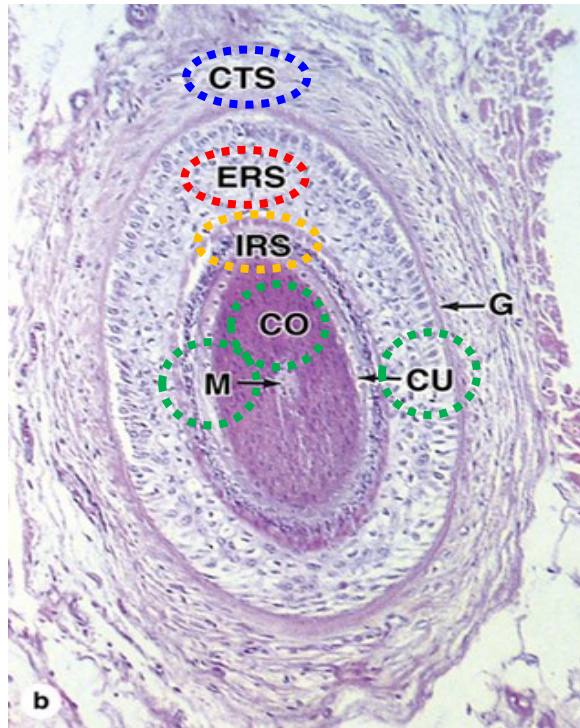
Velusové x Terminální chlupy



Struktura vlasu 1



Garther and Hiatt, Color textbook of histology, Elsevier

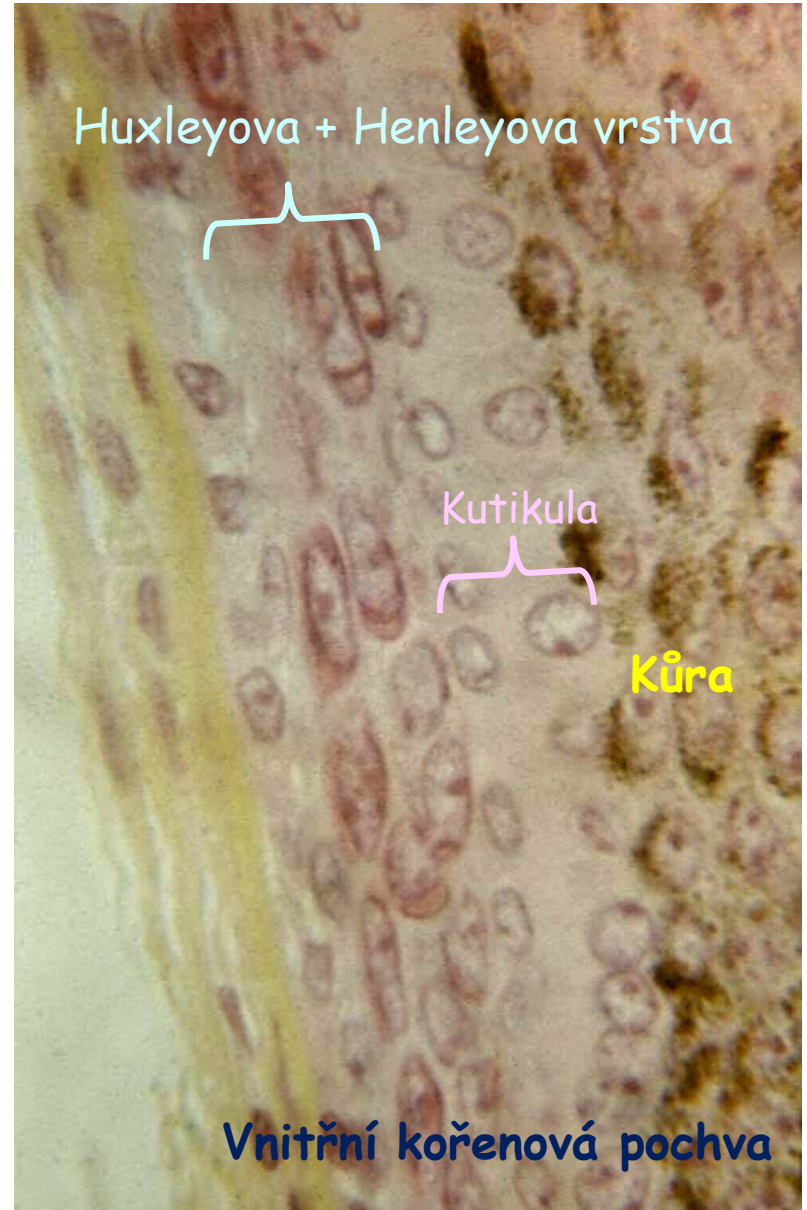


Struktura vlasu 2

Vnější kořenová pochva



Huxleyova + Henleyova vrstva

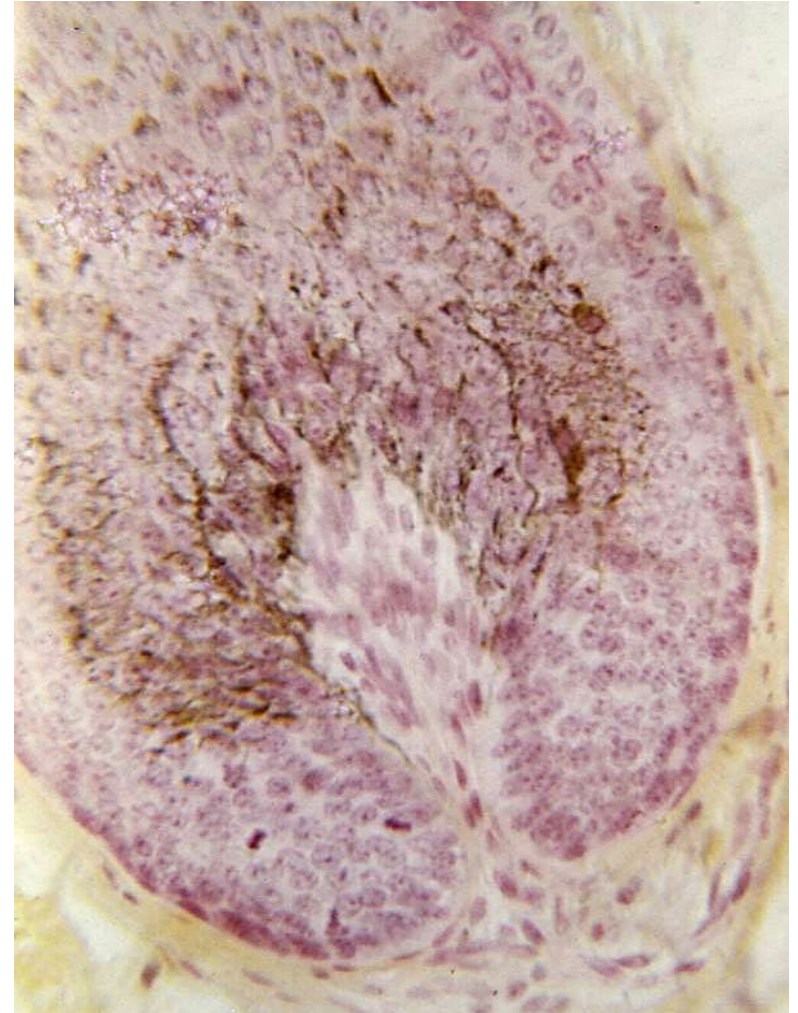
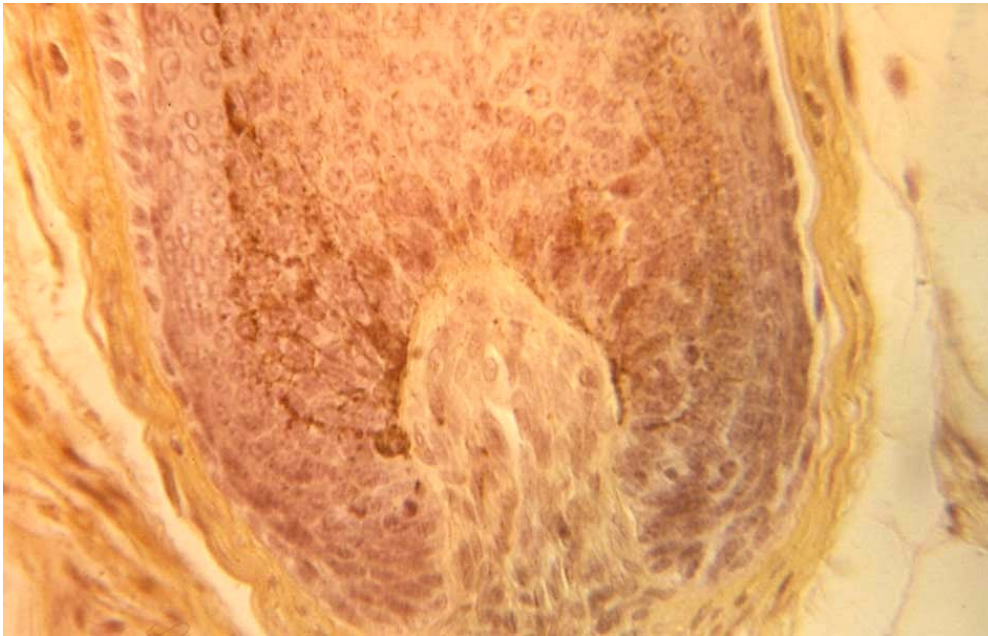


Kutikula

Kůra

Vnitřní kořenová pochva

Vlasová cibulka a papila



Vlasy - barva a tvar

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(a)



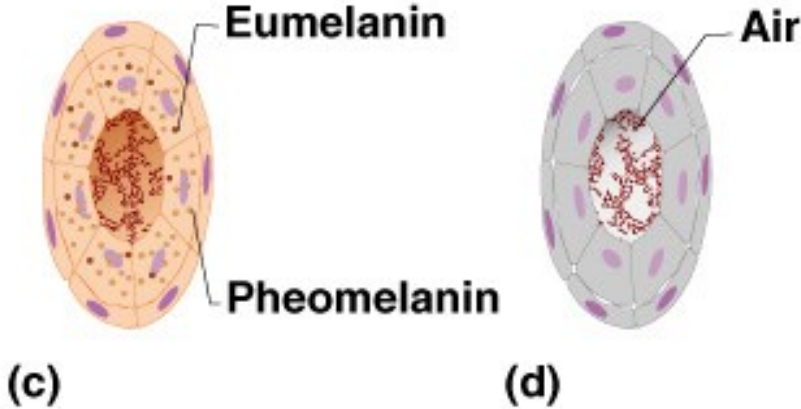
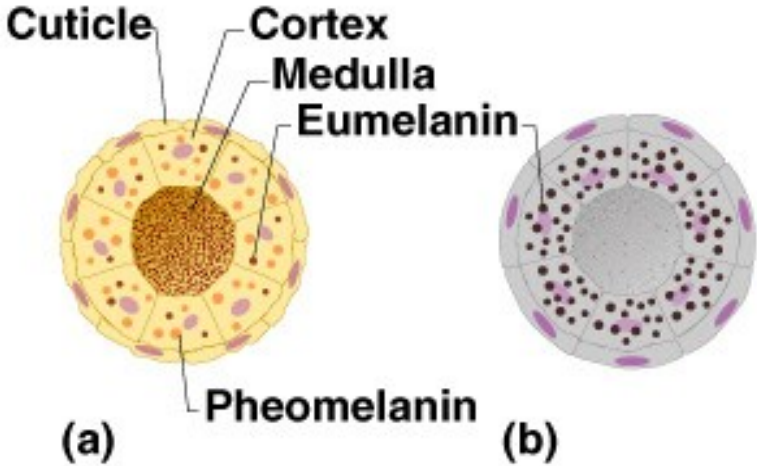
(b)



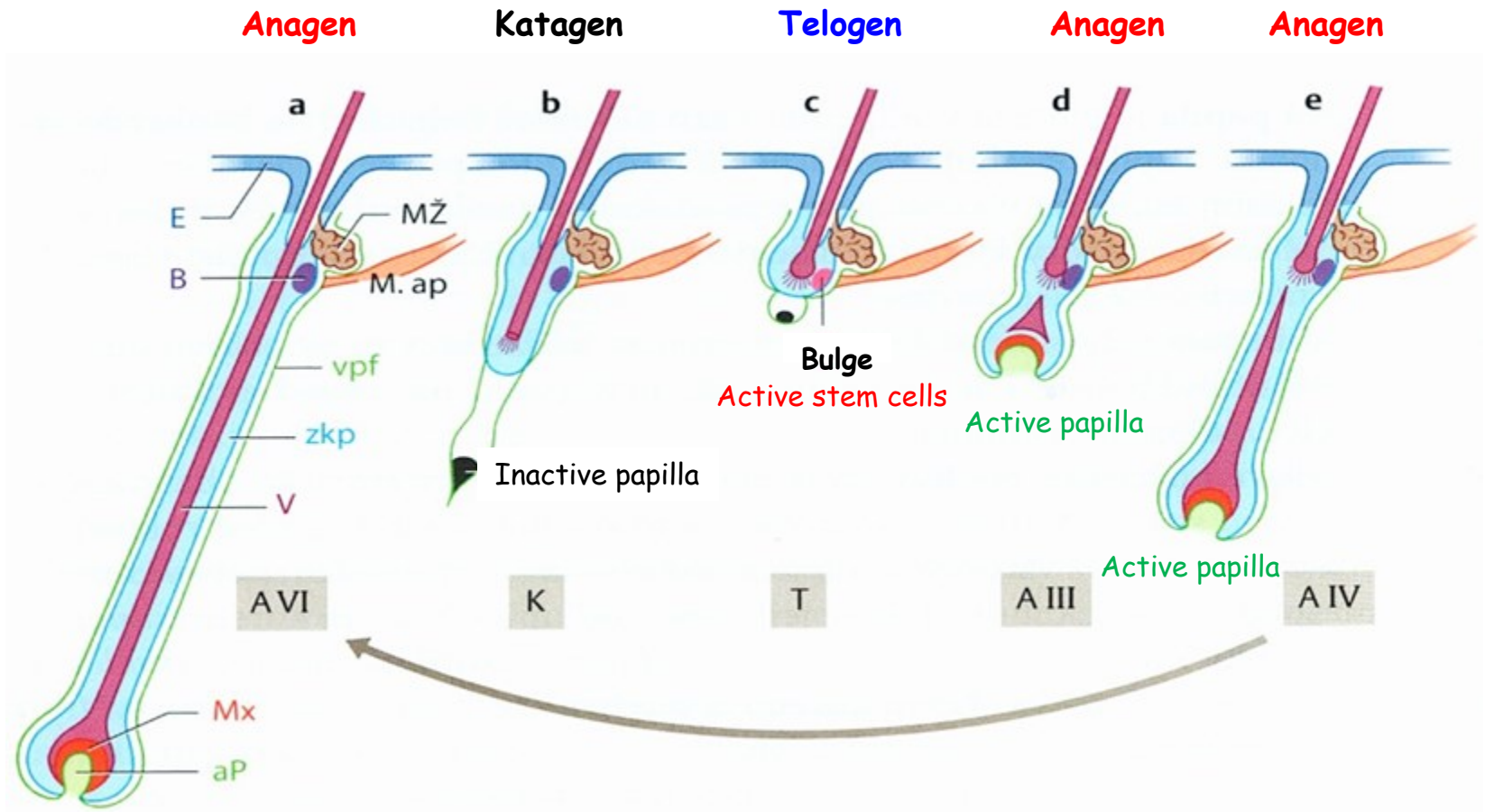
(c)



(d)



Vlasový cyklus



Active papilla

Anagen - months to years
Katagen - 3 weeks (involution)
Telogen - 3 months (resting)

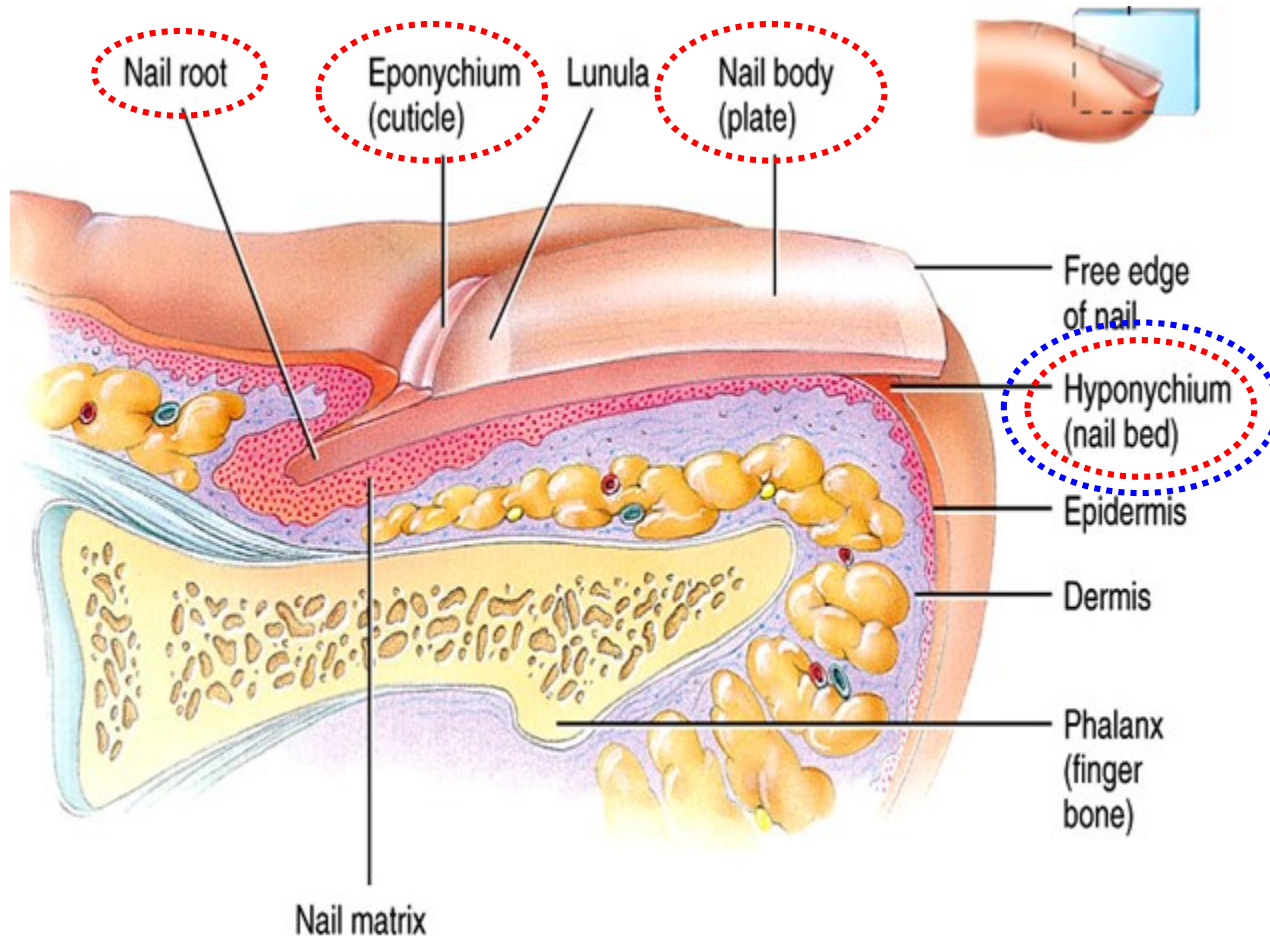
Nehet 1

Epidermové složky

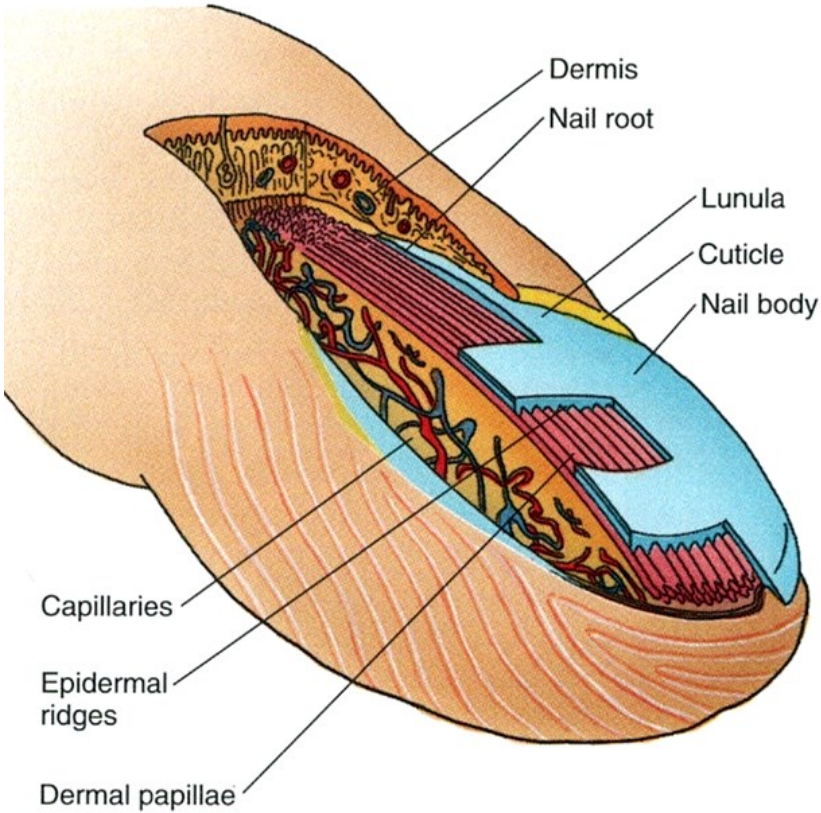
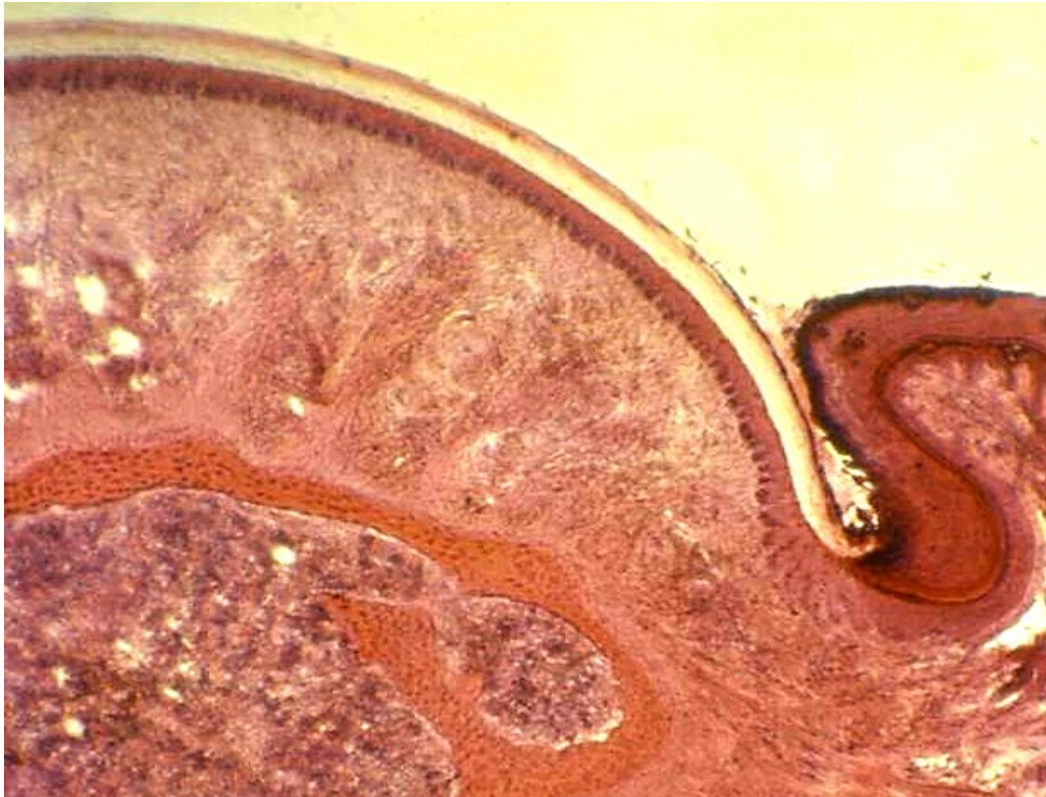
Nehtová ploténka (tělo) - str. corneum
Nehtový kořen - str. germinativum (prox.)
Hyponychium - str. germinativum (dist.)

Dermální složky

Hyponychium (nehtové lůžko)



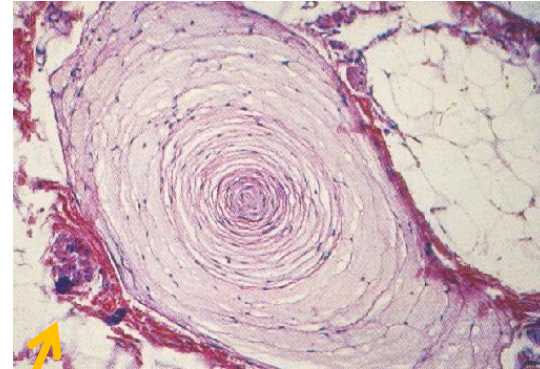
Nehet 2



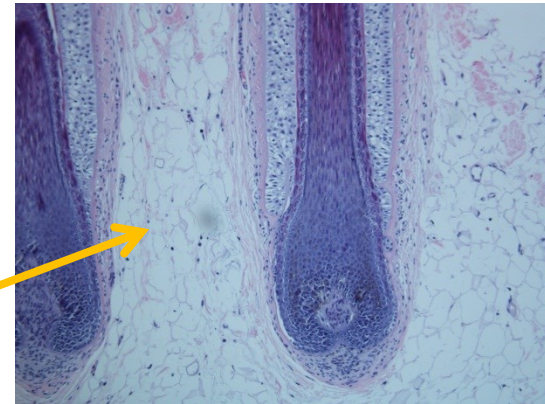
Podkoží - Hypodermis

Area deep to the dermis

- Řídké vazivo obsahující adipocyty, nervy, sensorické receptory, arterie a vény (deep rete cutaneum)
- Provides a flexible attachment to the underlying muscle and fascia



Pacinian Corpuscle



Hair bulb in the subcutis of the scalp

Adipocytes

Vývoj kůže

Ektoderm

- Epidermis
- Adnexa

Mesenchym

(mesoderm - dermatomy + nesegmentovaný mesoderm - somatopleura)

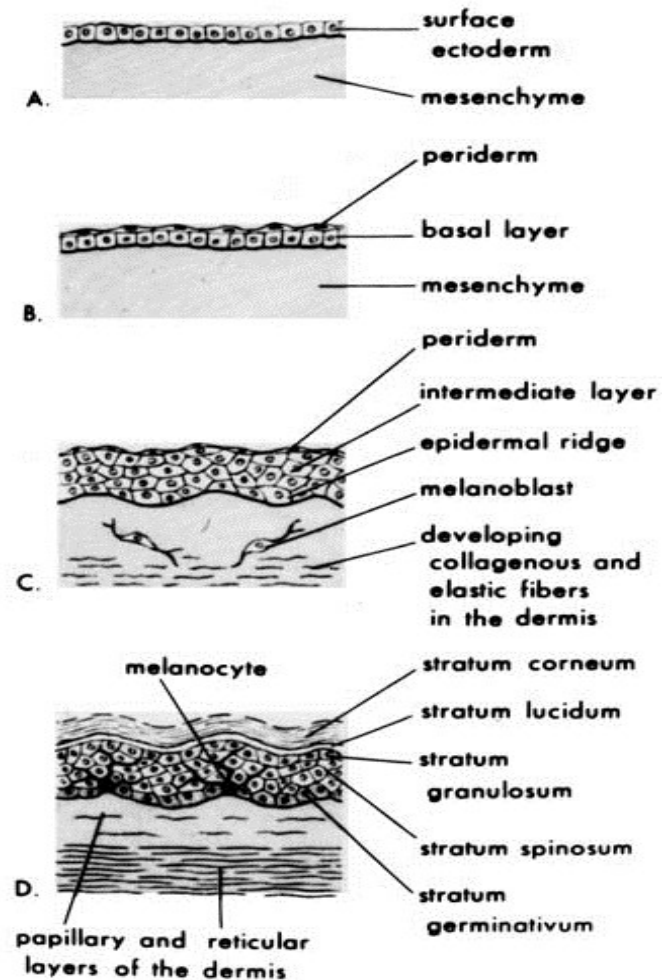
- Dermis
- Hypodermis

A - Month 1 - simple surface ektoderm

B - Month 2 - two layered epithelium:
basal layer + **periderm** (epitrichium)

C - Month 3 - basal + intermediary +
periderm layers
(week 10-17 - formation of dermal ridges)

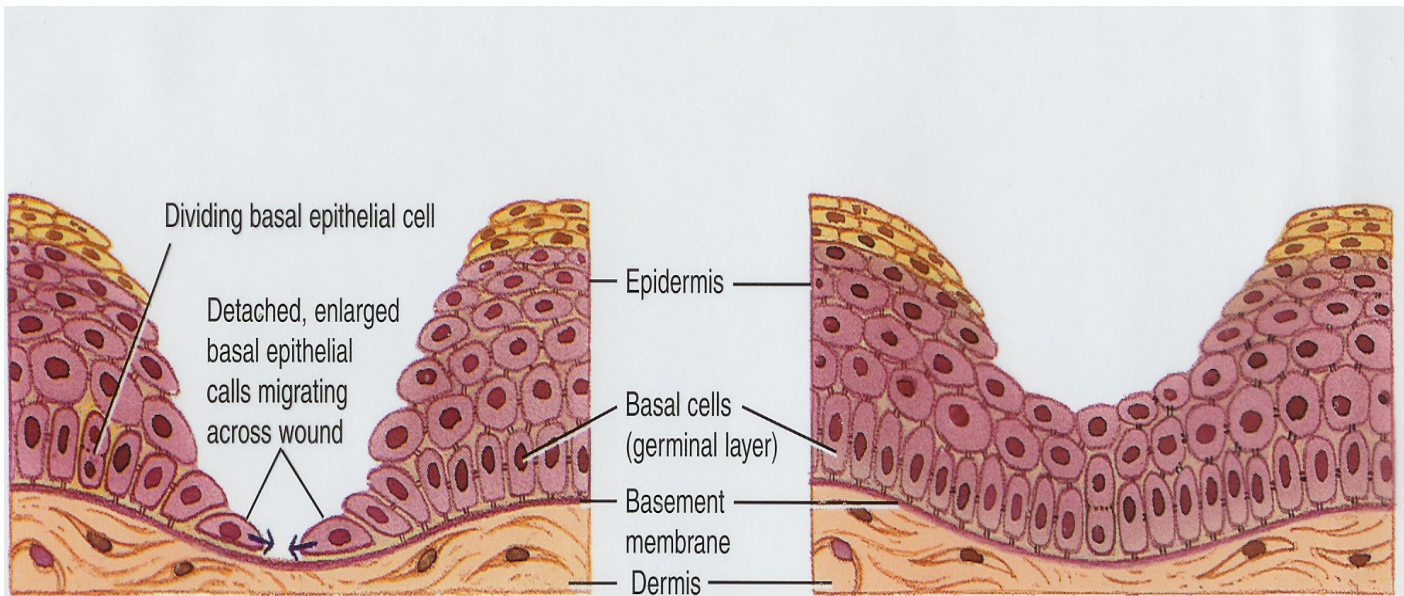
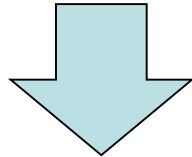
D - Month 5 (end) - periderm replaced
by **stratum corneum**



Hojení kožních ran 1

Povrchové rány

Hluboké rány



(a) Division of basal cells and migration across wound

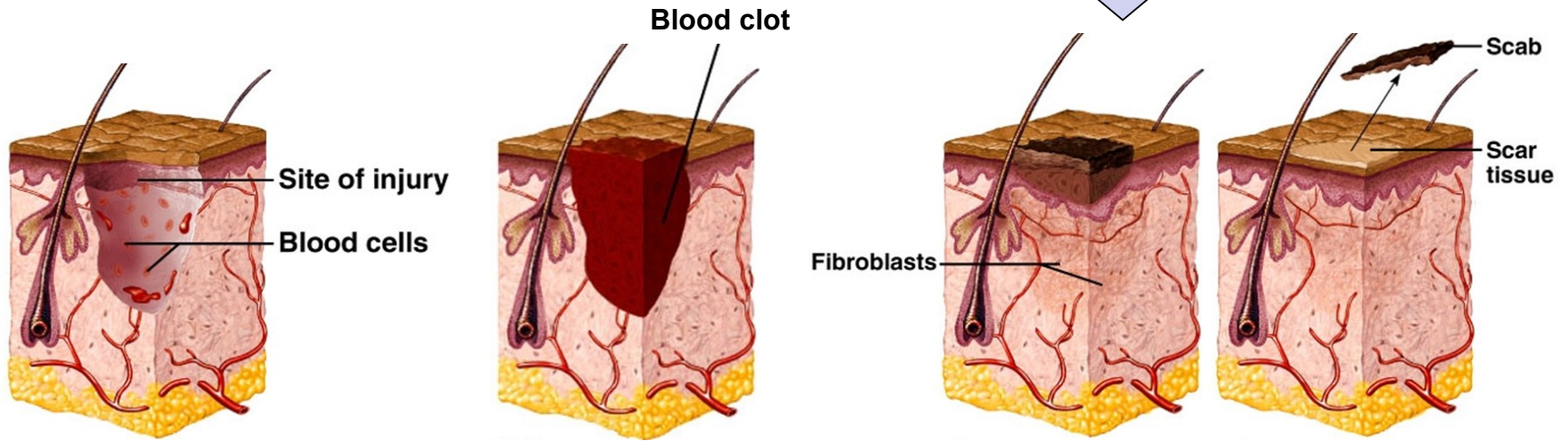
(b) Resurfacing of wound

cell migration → contact inhibition

Hojení kožních ran 2

Povrchové rány

Hluboké rány



Inflammatory phase



Migratory phase → Maturation phase
+
Proliferative phase

Fibrin tvoří sraženinu

Fibroblasty tvoří granulační tkáň
hypertrophic scar = keloid

Děkuji za pozornost !

Questions and comments at:
ahampl@med.muni.cz

Aging and the Integumentary System

Effects:

- wrinkling
- decrease of skin's immune responsiveness
- dehydration and cracking of the skin
- decreased sweat production
- decreased numbers of functional melanocytes resulting in gray hair and atypical skin pigmentation
- loss of subcutaneous fat
- a general decrease in skin thickness
- an increased susceptibility to pathological conditions
- Growth of hair and nails decreases; nails may also become more brittle with age.