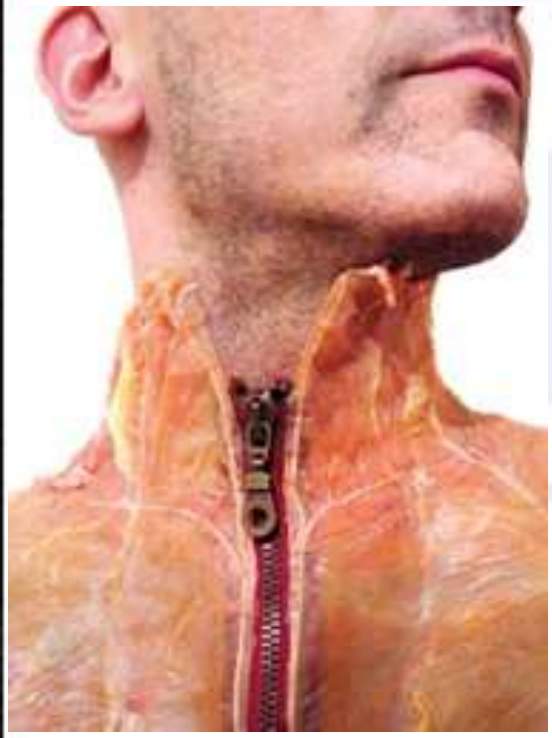
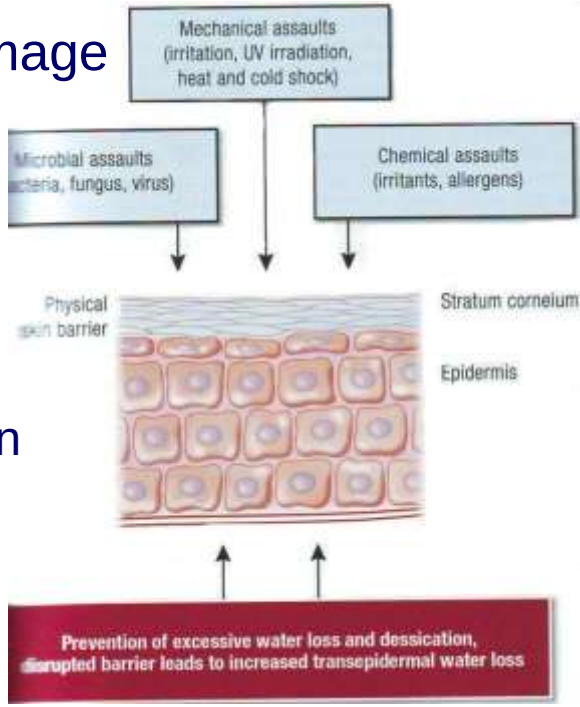


The integument

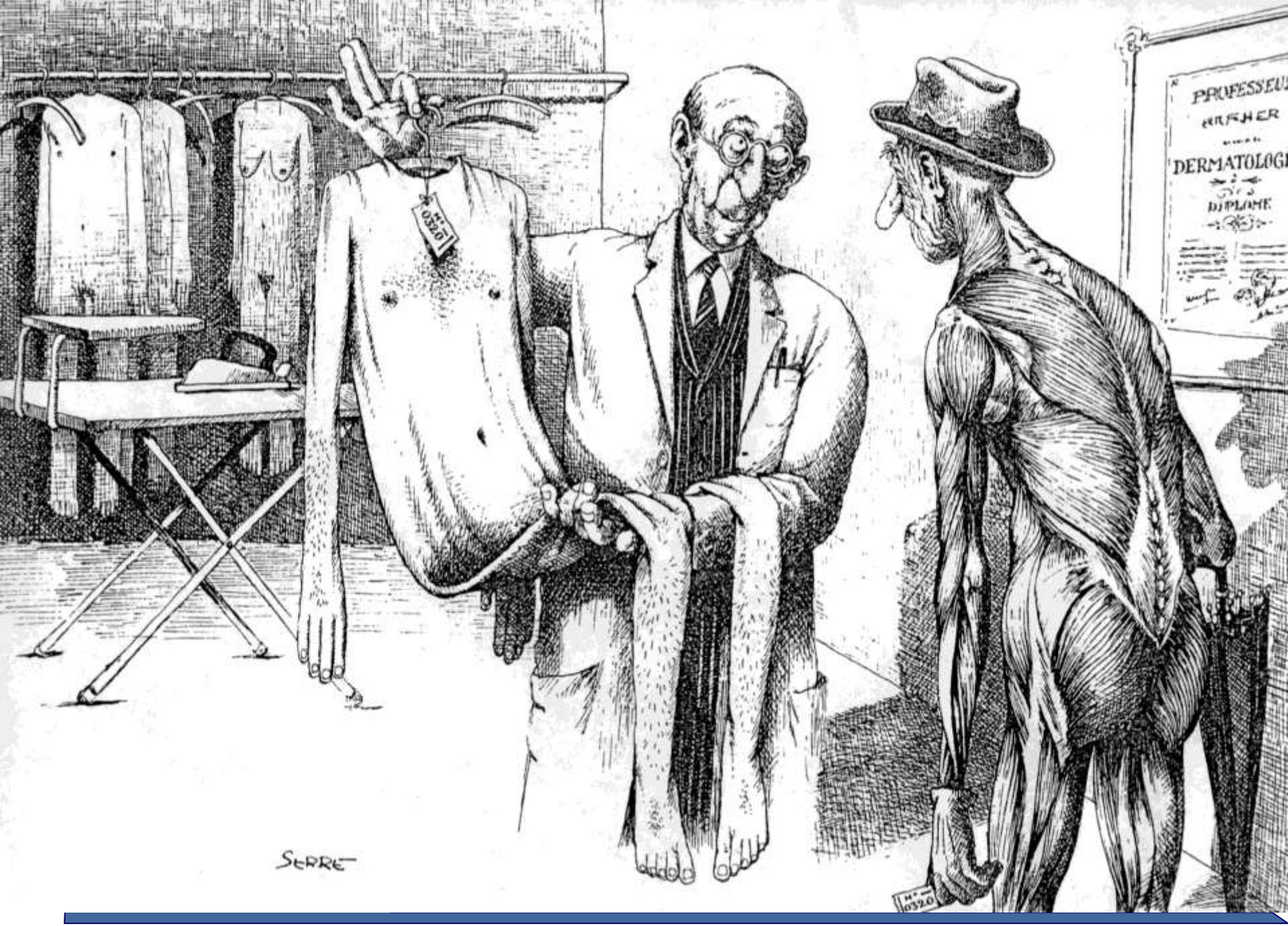
1. Skin and its main functions
2. Structure of the skin:
   - ✓ epidermis – microscopic structure
   - ✓ dermis – microscopic structure
   - ✓ hypodermis (subcutaneous tissue)
3. Appendages of the skin:
   - ✓ hairs and nails
   - ✓ sebaceous and sweat glands
4. Mammary gland, mamma

Skin and skin functions

- the largest single organ of the body: ~16% (~4 kg) of the total body weight
- major role – a barrier between the organism and the environment:
  - ✓ protection of the body against pathogens and damage
- some other functions:
  - ✓ thermal insulation and heat regulation
  - ✓ excretion by sweating ⇨ temperature regulation
  - ✓ control of evaporation and water resistance:
    - ➢ prevents excessive water loss and body dessication
  - ✓ storage and synthesis:
    - ➢ storage center for lipids and water
    - ➢ synthesis of vitamin D
  - ✓ absorption – oxygen, nitrogen and carbon dioxide, medicine
  - ✓ sensation – nerve endings, cutaneous receptors
  - ✓ aesthetics and communication



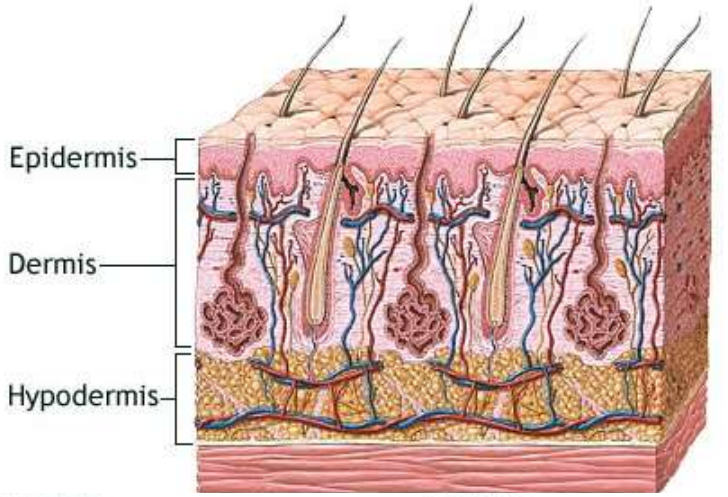
*NB: The adjective **cutaneous** literally means "of the skin" (from Latin cutis,* skin)

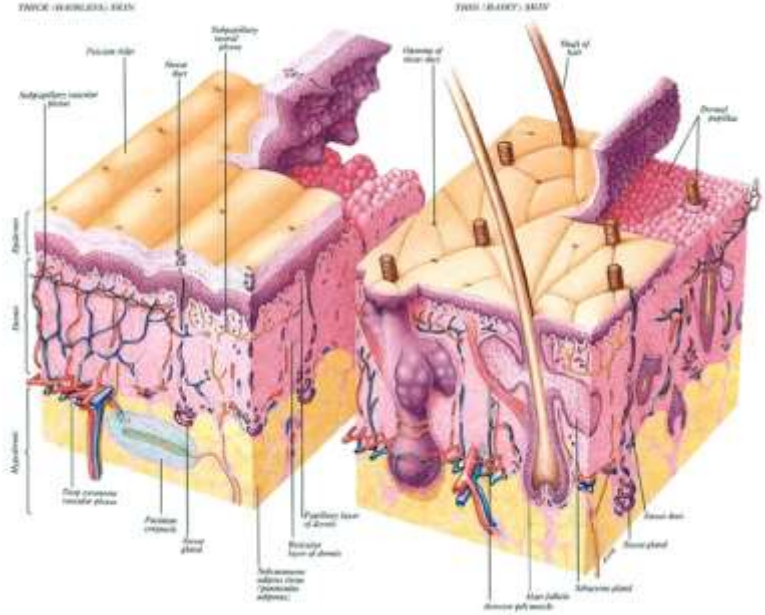


NB: Human skin: the most valuable 2 m²!

Structure of the skin

- two major layers – Gr. *derma*, skin:
  - ✓ **epidermis**
    - ➢ epithelial layer
    - ➢ derived from embryonic ectoderm
    - ➢ generates skin appendages
    - ➢ high capacity of regeneration
    - ➢ non-vascular but richly innervated
  - ✓ **dermis** (corium)
    - ➢ connective tissue layer
    - ➢ mesenchymal origin
    - ➢ highly vascularized
  - ✓ **hypodermis** (subcutis)
    - ➢ loose irregular connective and fatty tissue, *panniculus adiposus*
- two skin types – thickness of the epidermis:
  - ✓ thick (glabrous, hairless) skin
    - ➢ palms and soles – 1.5 mm
  - ✓ thin (hairy) skin – 0.08 mm
    - ➢ elsewhere on the body
    - ➢ thinnest on the eyelids – 0.05 mm





Dactyloscopy

- **skin surface:**
  - ✓ "epidermal ridges“, cristae cutis
  - ✓ sulci cutis
  - fingerprint =

impression of the friction ridges on all parts of the finger

Henry Faulds (1843-1930)

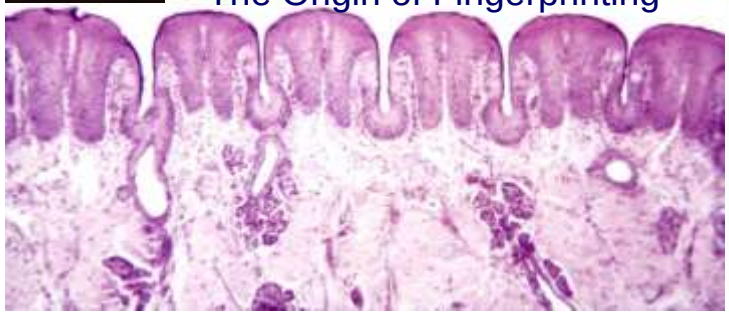
the forensic use of fingerprints

  - dactyloscopy =

fingerprint identification, palm print identification

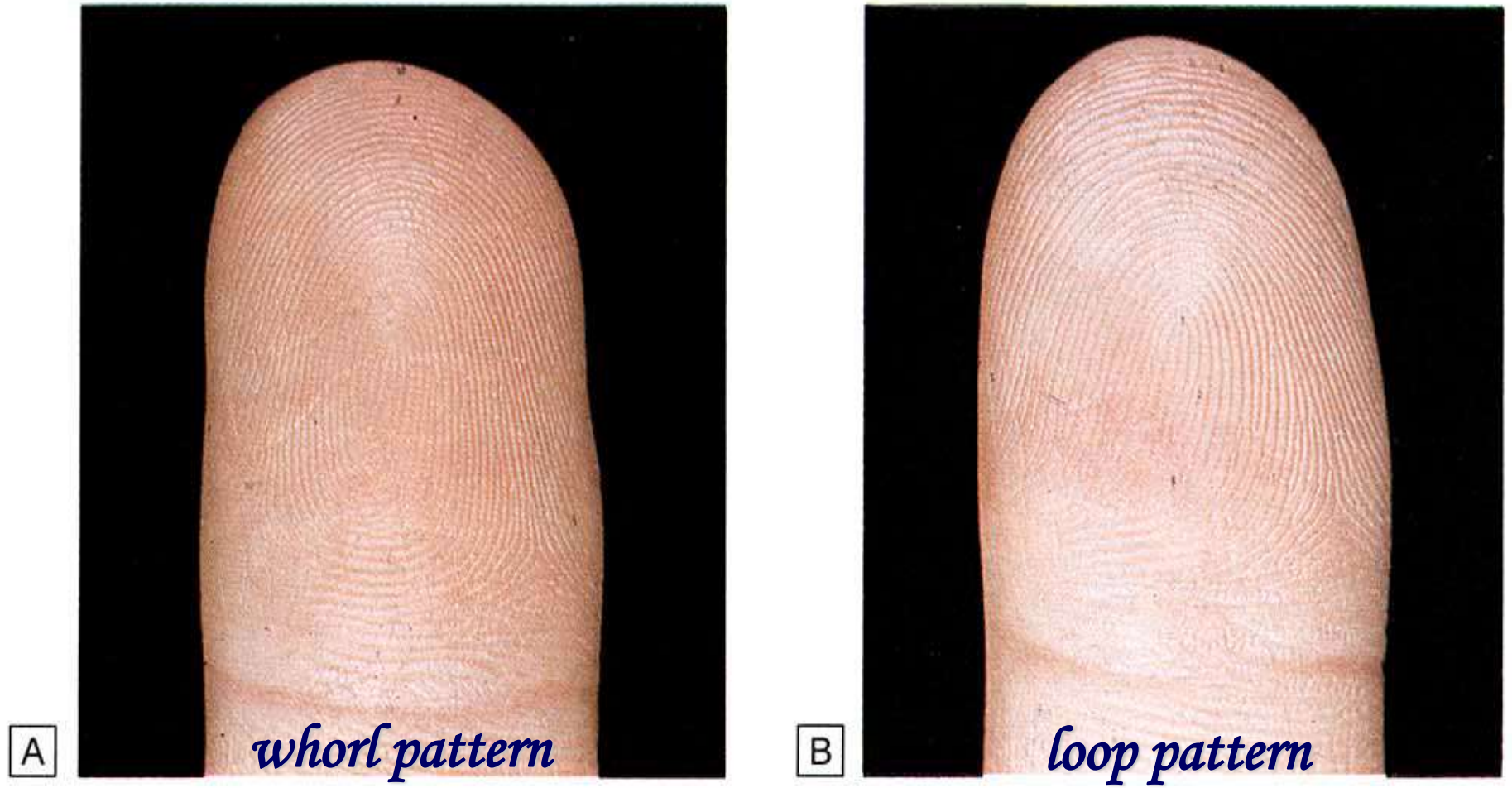
Sir William Herschel (1833-1917)

'The Origin of Fingerprinting'



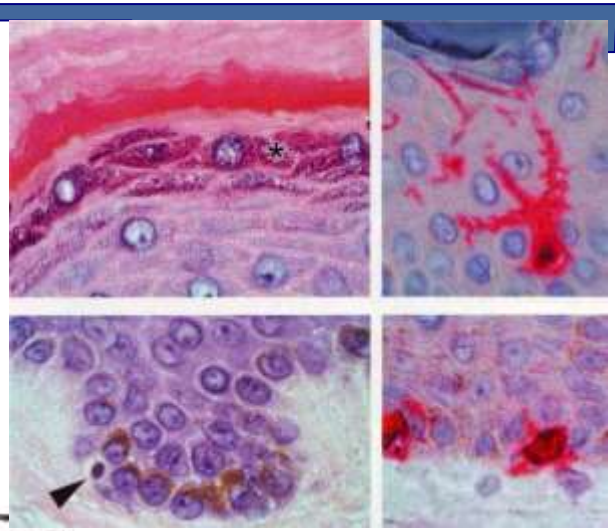
Dermatoglyphics

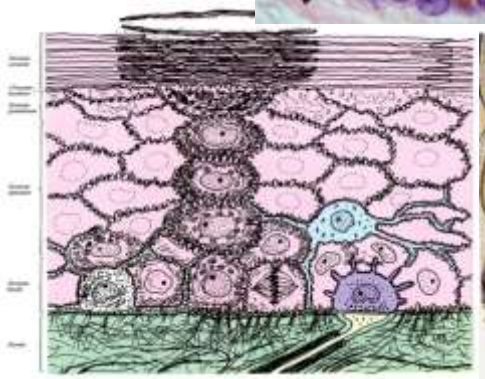
- ✓ **dermatoglyphs** are present on fingers, palms, toes, and soles
- ✓ dermatoglyphic patterns give insight into a critical period of embryogenesis and often relate to chromosomal abnormalities and genetic disorders

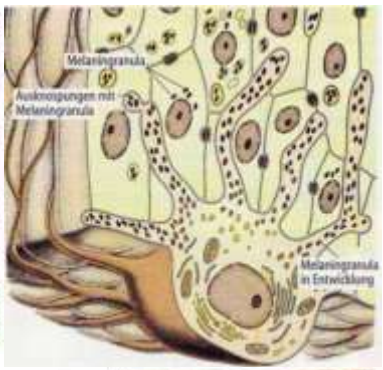


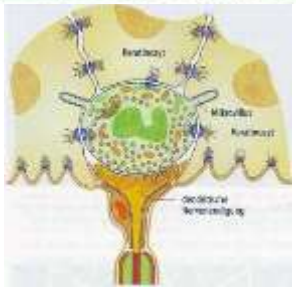
Epidermis

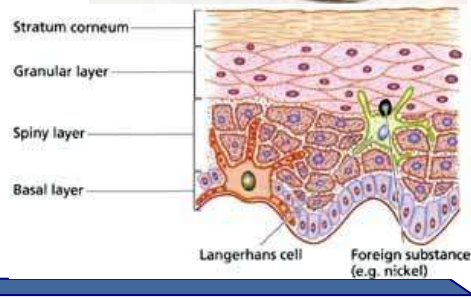
- stratified squamous keratinized epithelium
- main cell types:
  - ✓ **keratinocytes** – 85-95% of all epidermal cells
    - ➢ keratin-producing cells
  - ✓ **melanocytes**
    - ➢ neural crest cells
    - ➢ production and storage of melanin
    - ➢ darkening of the skin (tanning)
  - ✓ **Langerhans cells** – 2-8%
    - ➢ bone-marrow-derived macrophages
    - ➢ dendritic cells with Birbeck granules
    - ➢ immune, antigen-presenting cells
  - ✓ **Merkel cells**
    - ➢ present in the thick skin
    - ➢ "touch cells" ⇨ mechanoreceptors
    - ➢ APUD cells ⇨ neuroendocrine function





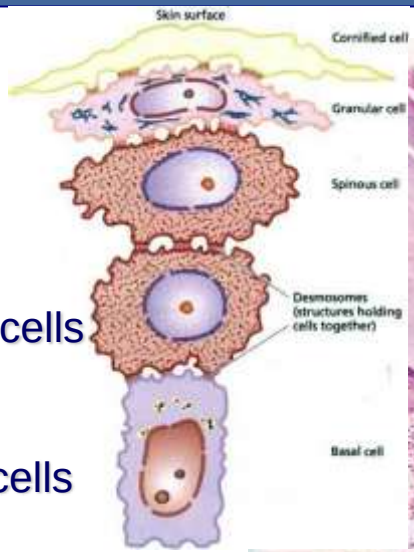


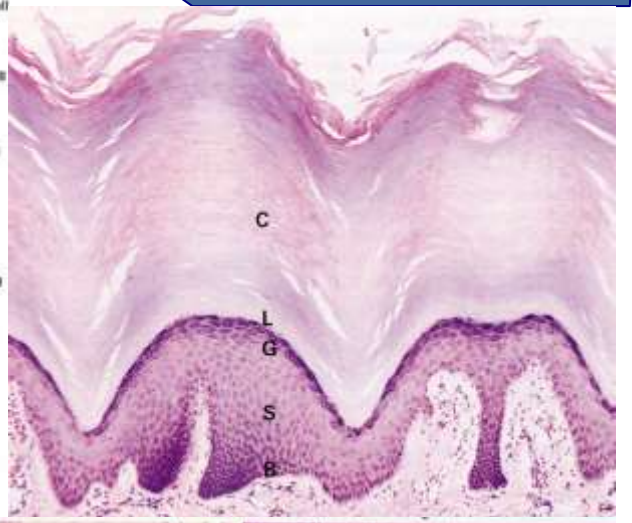


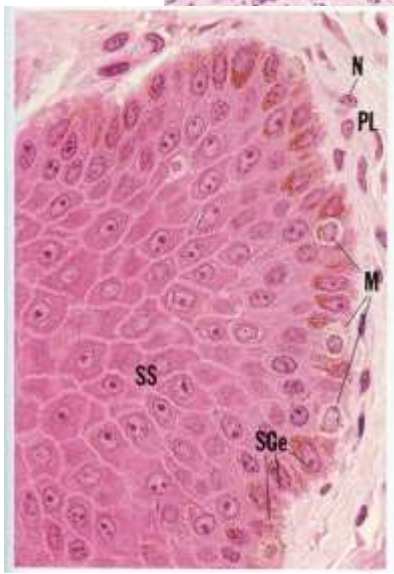


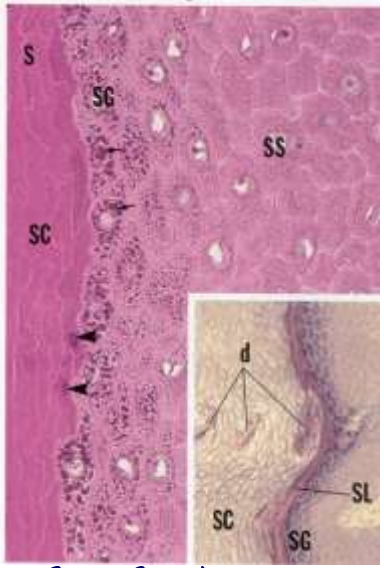
Epidermis – microscopic structure

- 5 layers of keratinocytes:
  - ✓ **stratum basale (germinativum)**
    - ➢ single layer of columnar cells
    - ➢ renewal of the epidermis
  - ✓ **stratum spinosum**
    - ➢ several layers of polygonal spiny cells ⇨ desmosomes
  - ✓ **stratum granulosum**
    - ➢ 3-5 layers of flattened polygonal cells with keratohyalin granules
  - ✓ **stratum lucidum**
    - ➢ only in thick skin
    - ➢ flattened eosinophilic cells
  - ✓ **stratum corneum**
    - ➢ 15-20 layers of flattened nonnucleated keratinized (horny) cells
- keratinization:
  - ➢ every 15-30 days
  - ➢ due to mitotic activity of the malpighian layer









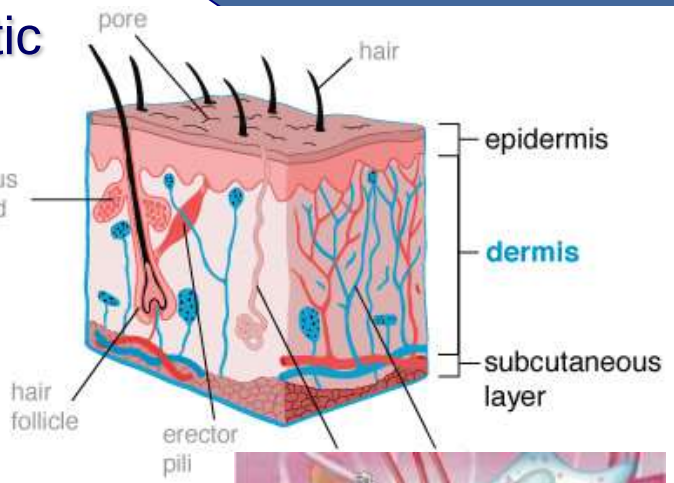
NB: Mnemonics for remembering the layers of the skin:

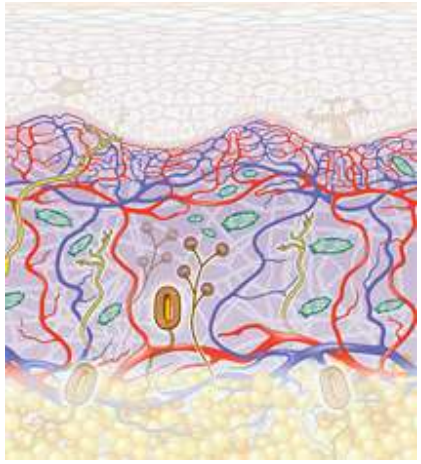
"Cher Likes Getting Skin Botoxed" (from superficial to deep)

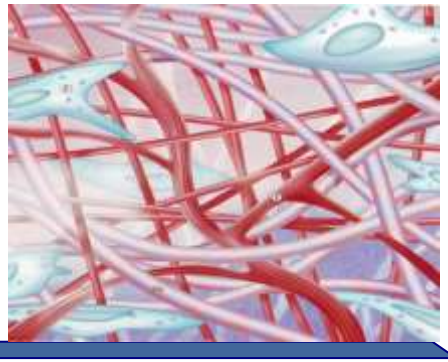
"Before Signing, Get Legal Counsel" (from deep to superficial)

Dermis, corium

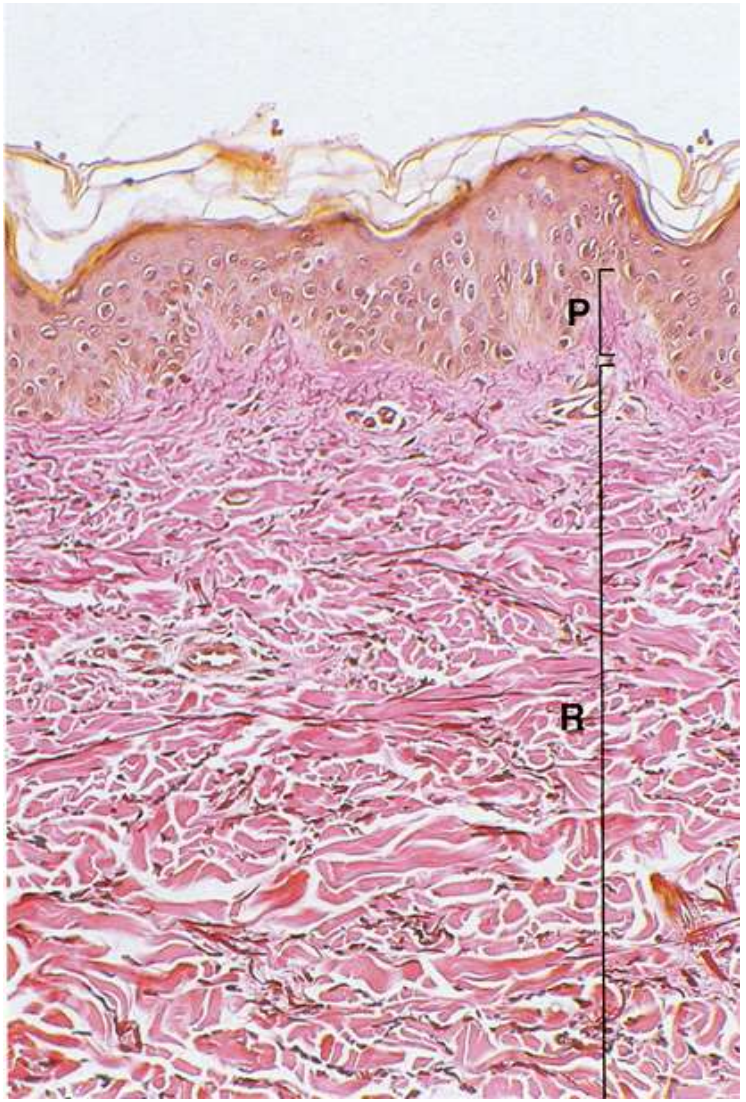
- connective tissue – though, flexible and elastic
- variable thickness – max. 4 mm on the back
- two layers:
  - ✓ papillary layer – thin and superficial:
    - ➢ dermal papillae ⇨ ridges
    - ➢ loose connective tissue
      - collagen fibers ⇨ anchoring fibrils
      - fibroblasts, mast cells, macrophages
    - ➢ increase and reinforce dermal-epidermal junction
  - ✓ reticular layer – deep and much thicker:
    - ➢ irregular dense connective tissue
      - collagen type I and elastic fibers
      - fewer cells
- rich lymph and capillary network – 4.5% of the blood volume
- epidermal derivatives





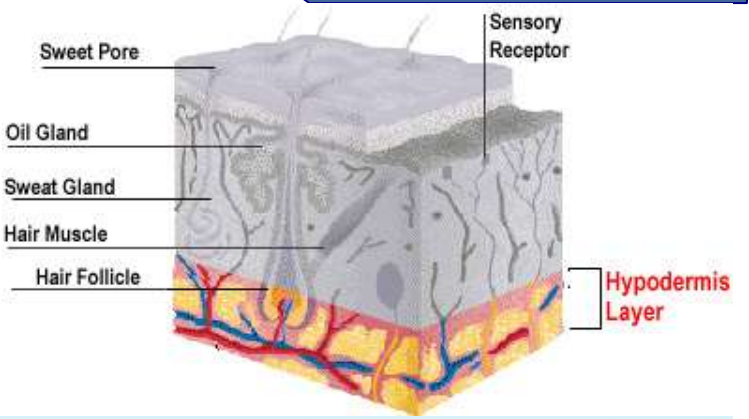


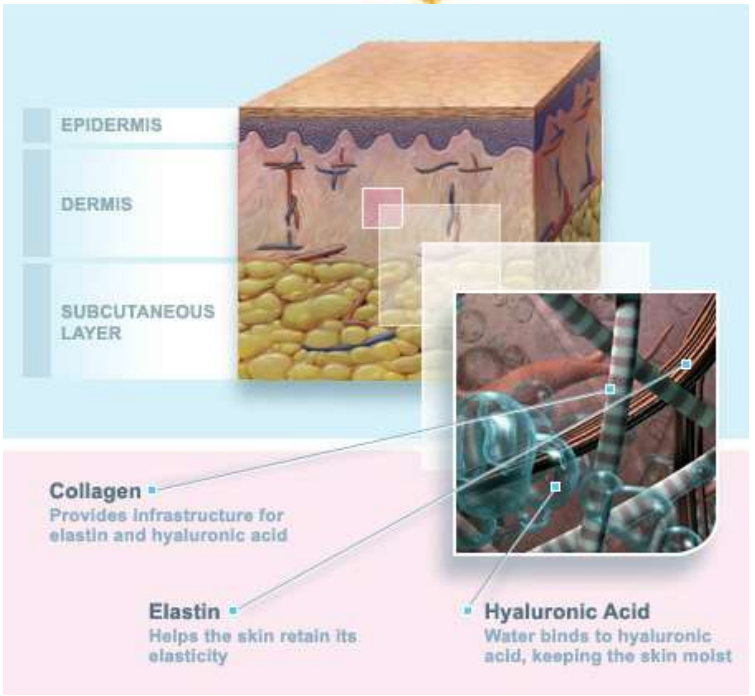
Dermis – microscopic structure

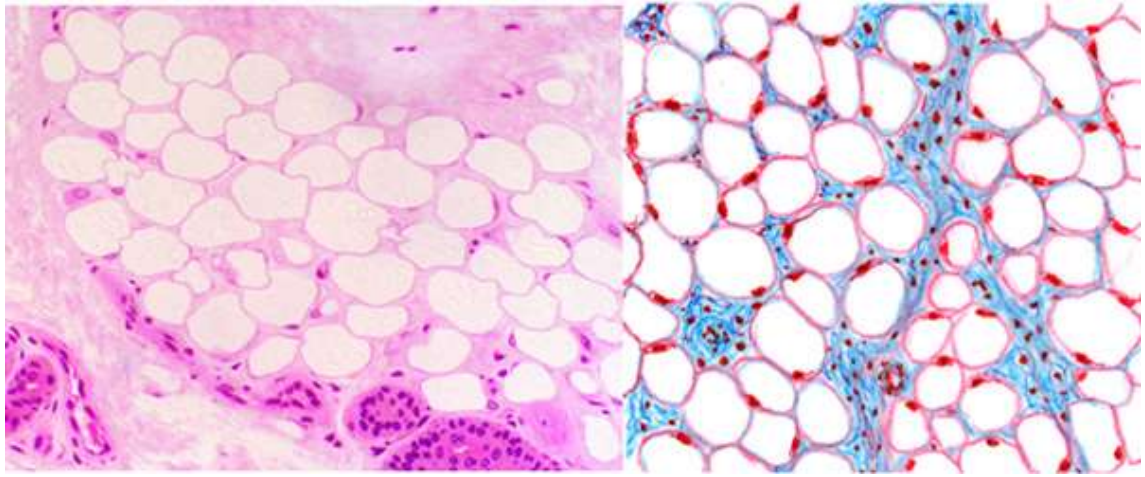


Hypodermis

- subcutaneous tissue – synonyms: superficial fascia, *panniculus adiposus:*
  - ✓ loose connective tissue and elastin
    - ➢ binds the skin loosely to the subjacent organs
    - ➢ supplying skin with blood vessels and nerves
    - ➢ renewal of the epidermis
  - ✓ components:
    - ➢ fat cells – varying in number and size, contains 50% of body fat
    - ➢ fibroblasts, macrophages

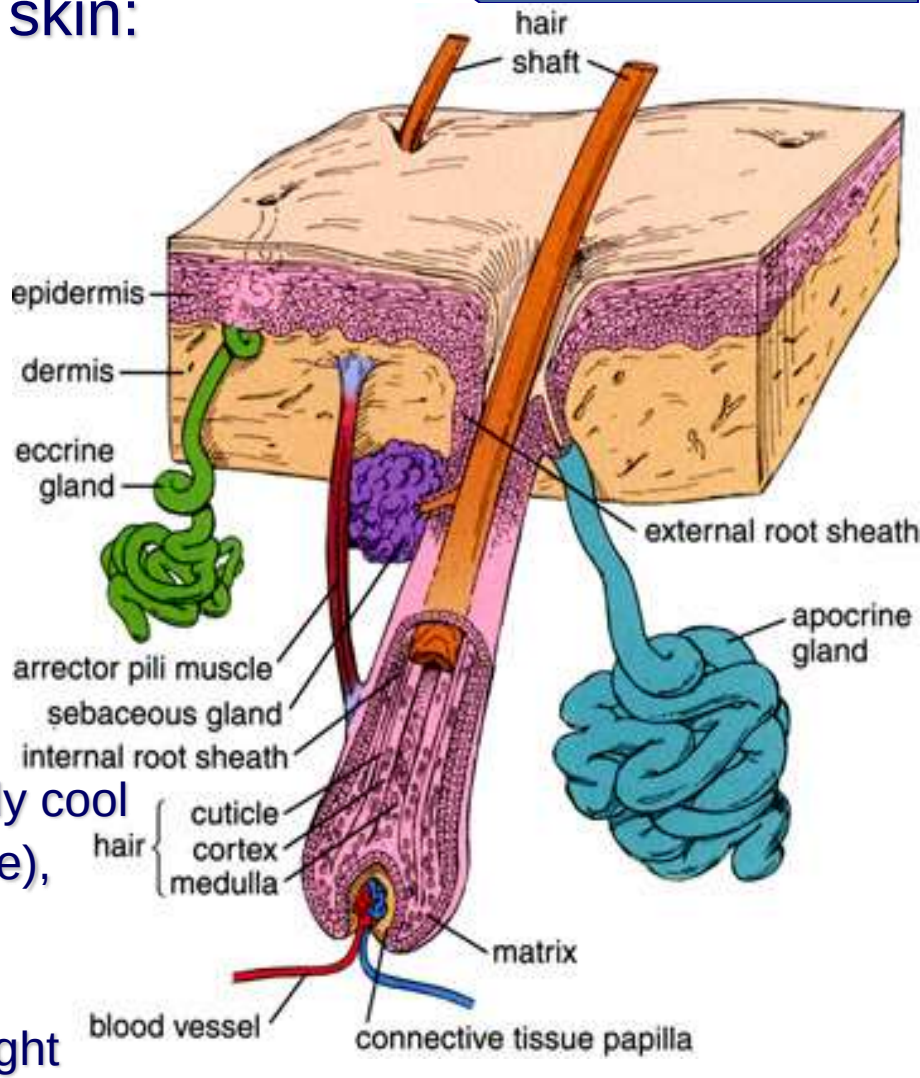






Skin appendages

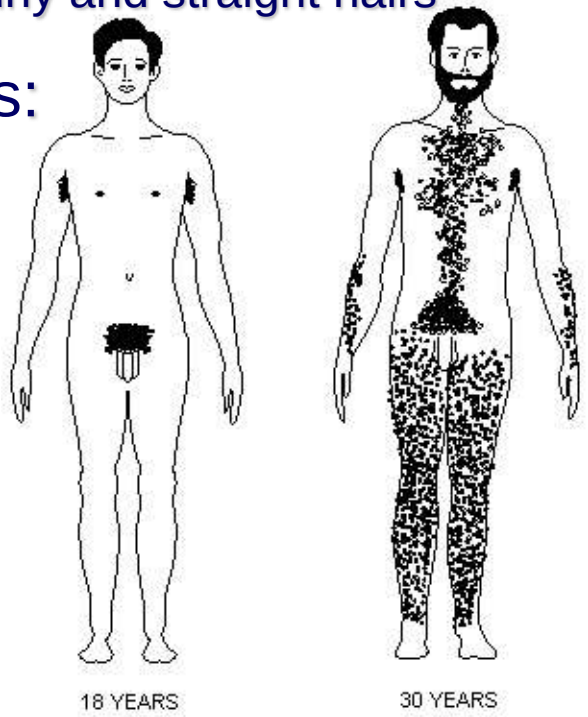
- appendages associated with the skin:
  - ✓ **hairs** – functions:
    - ➢ sensation
    - ➢ heat loss
    - ➢ filter for breathing
    - ➢ protection
  - ✓ **nails** – function:
    - ➢ protection
  - ✓ **sebaceous glands** – function:
    - ➢ secrete sebum onto hair follicle to oil the hair
  - ✓ **sweat glands** – function:
    - ➢ produce sweat to help keep the body cool
    - ➢ secreted with strong odour (apocrine), with a faint odour (eccrine)
  - ✓ **arrector pilli muscle** – function:
    - ➢ smooth muscle that pulls hairs straight

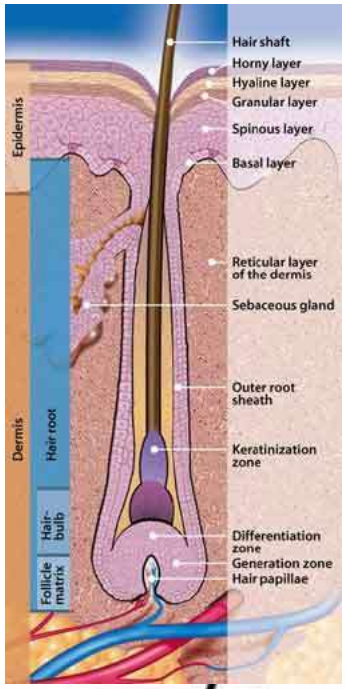


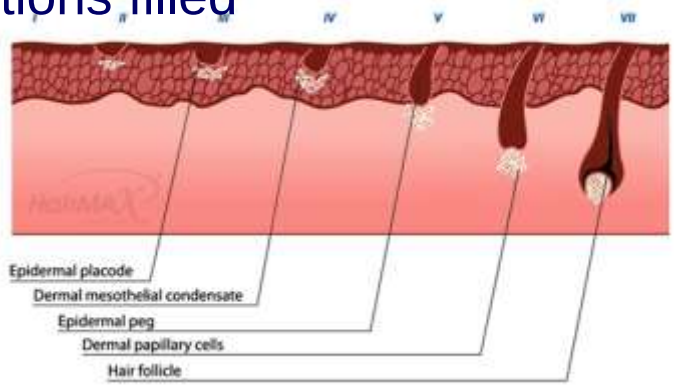
Hairs and their embryogenesis

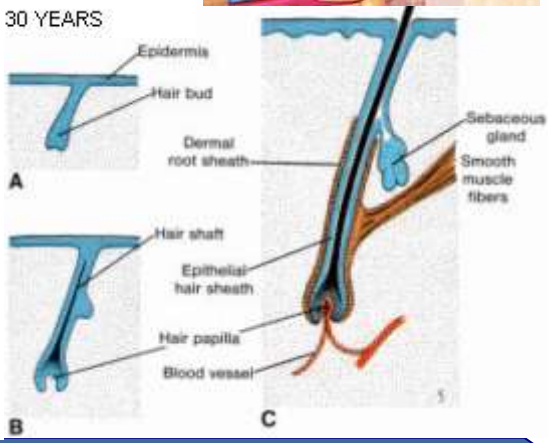
- Lat. *pilli*, Gr. *thryx, thrychos*
- elongated keratinized structures:
  - ✓ found everywhere with exception of:
    - ➢ palms and soles
    - ➢ lips and eyelids
    - ➢ glans penis
    - ➢ glans clitoridis and labia minora
  - ✓ arise from an epidermal invagination, hair follicle
- embryonic development:
  - ✓ epidermal proliferations penetrating the underlying dermis
  - ✓ hair papillae, invaginations filled with mesoderm
  - ✓ vessels and nerve endings develop
  - ✓ dermal root sheath – formed by surrounding mesenchyme

curly and straight hairs



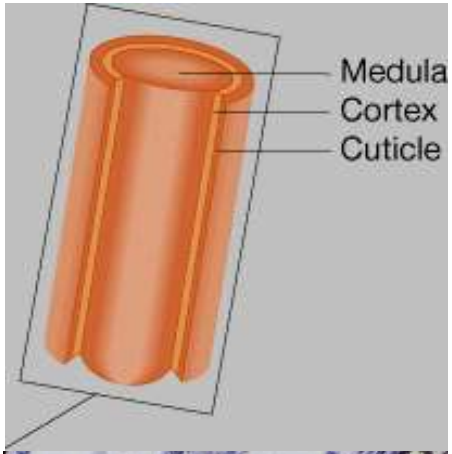


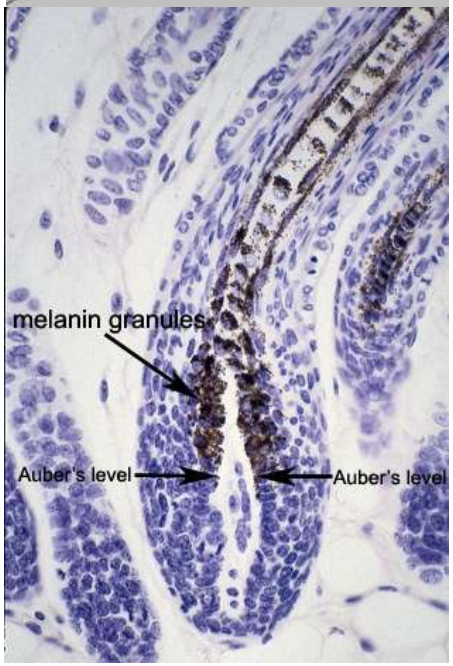


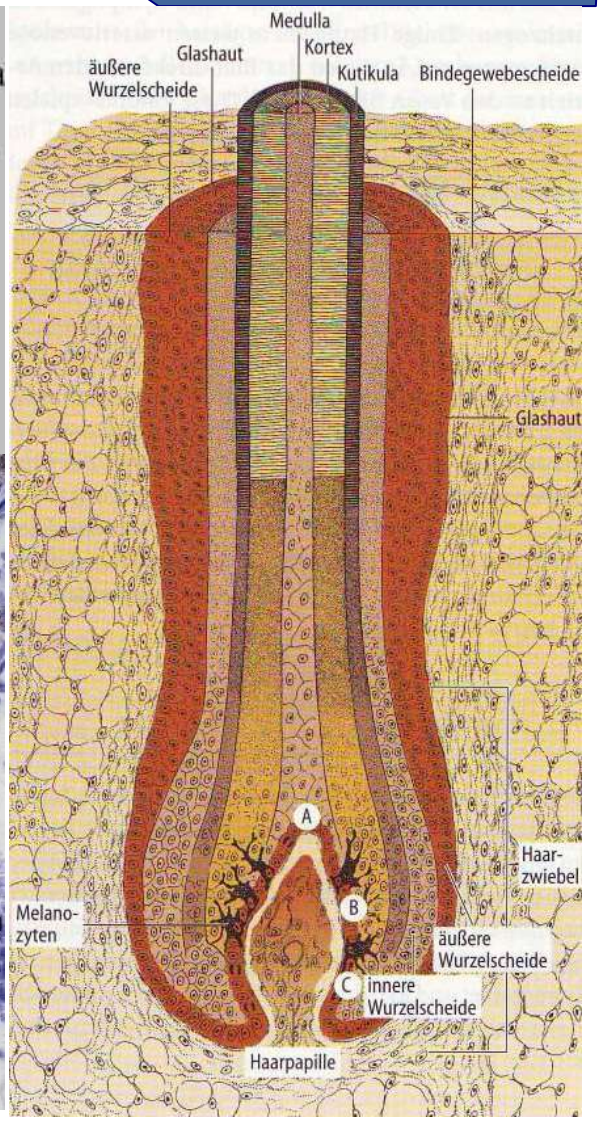


Hair structure and colour

- three parts length-wise:
  - ✓ **hair bulb** – stem cells
  - ✓ **hair root** – beneath the skin surface
  - ✓ **hair shaft** – above the skin surface
- three parts in cross-section:
  - ✓ **hair medulla** – area in the core:
    - ➢ contains loose cells and airspaces
  - ✓ **hair cortex**:
    - ➢ contains densely packed keratin
    - ➢ responsible for the pigmentation, shape and texture of hair
  - ✓ **hair cuticle**:
    - ➢ single layer of cells covering the cortex
    - ➢ last cell line to differentiate
- natural hair colours:
  - ✓ *phaeomelanin* – responsible for the yellowish-blond to red colors
  - ✓ *eumelanin* is responsible for the brown to black shades
  - ✓ gray hair – little or no pigment

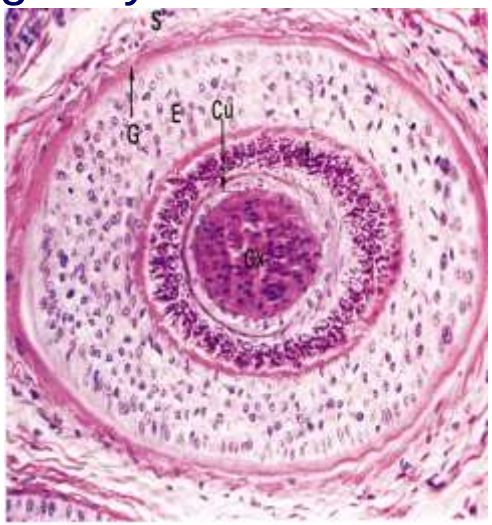


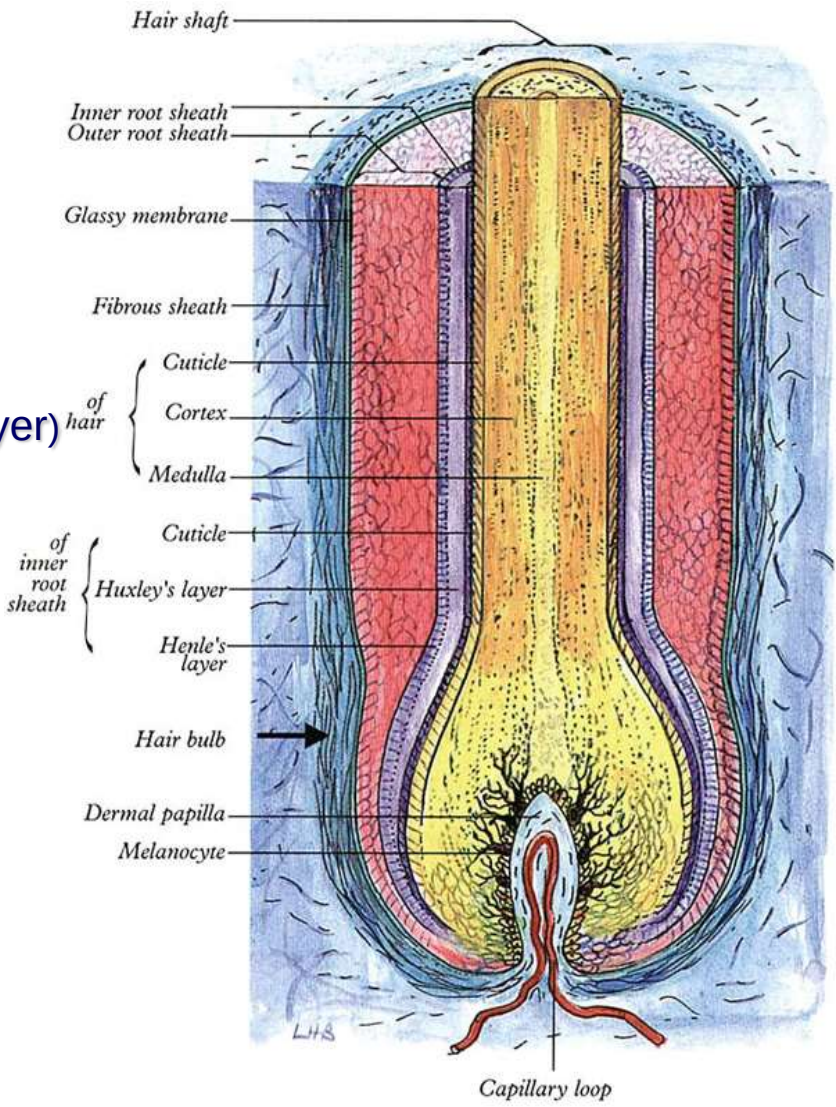




Hair follicle structure

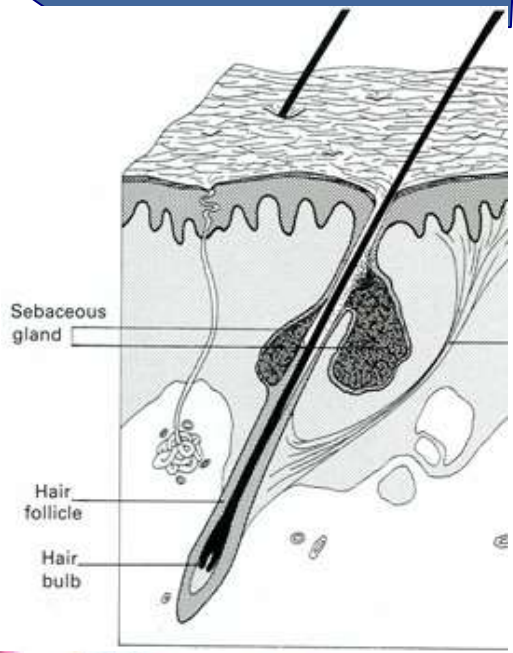
- papilla:
  - ✓ connective tissue and a capillary loop
- hair matrix:
  - ✓ epithelial cells and melanocytes
- root sheath – two coats:
  - ✓ external (outer) root sheath
  - ✓ internal (inner) root sheath – three layers:
    - ➢ *stratum epitheliale pallidum* (*Henle's* layer)
    - ➢ *stratum epitheliale granuliferum* (*Huxley's* layer)
    - ➢ internal cuticle
- glassy membrane – noncellular hyaline layer

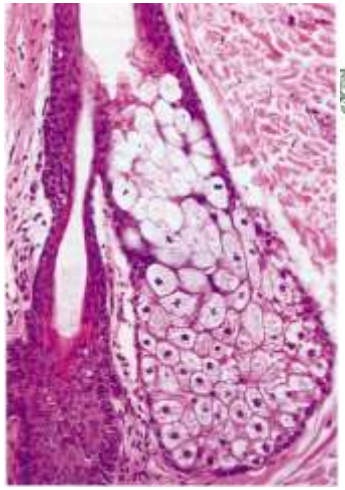


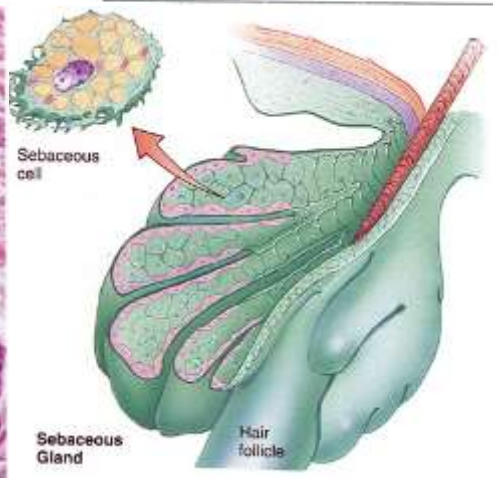


Sebaceous glands

- small, sacculated, holocrine glands:
  - ✓ embedded in the dermis; 100 glands/cm^2
  - ✓ absent in the glabrous skin of palms and soles
  - ✓ 400-900/cm^2 on the face, forehead and scalp
  - ✓ begin to function at puberty
- structure:
  - ✓ secretory portion:
    - ➢ 2-5 acini of undifferentiated flattened epithelial cells
    - ➢ larger fat-containing sebaceous cells
    - ➢ basal lamina
  - ✓ single short duct:
    - ➢ in the upper portion of a hair follicle
- **sebum** (Lat, *fat or tallow*) – functions:
  - ➢ complex mixture of lipids and waxes, triglycerides, squalene and cholesterol
  - ➢ natural lubricant of the hair and skin
  - ➢ antibacterial and antifungal properties
  - ➢ no importance in preventing water loss



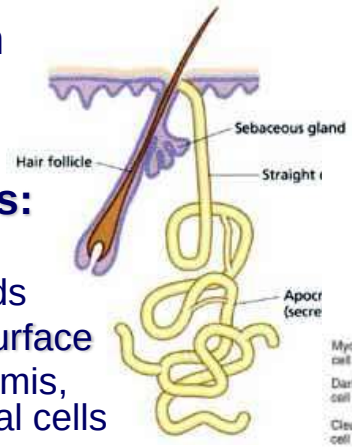


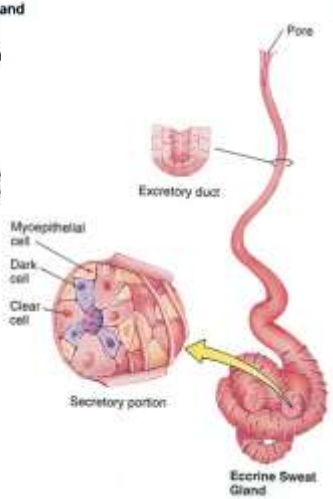


Sudoriferous (sweat) glands

- ✓ widely distributed in the skin
- ✓ absent in the glans penis

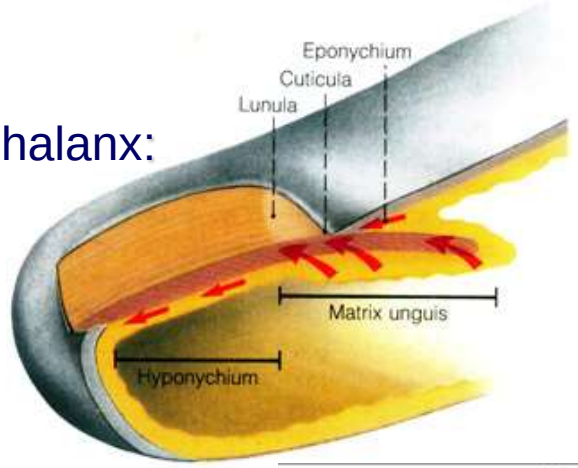
- two types:
  - ✓ **eccrine (merocrine) glands:**
    - most numerous
    - simple, coiled tubular glands
    - ducts opened at the skin surface
    - secretory portion in the dermis, surrounded by myoepithelial cells
      - dark (mucoid) cells ⇨ glycoproteins
      - clear cells – no secretory granules
    - innervated by cholinergic nerve endings
  - ✓ **apocrine glands:**
    - in axillae, eyelids, areola and nipple, anal region, embedded in the subcutaneous tissue
    - much larger (3-5 mm in diameter)
    - tubular with extensive coiled secretory portion
    - cuboidal cells with secretory granules
    - straight ducts opened into hair follicles
    - produce odorless viscous secretion
    - innervated by adrenergic nerve endings
- **sweat** – functions:
  - clear and not viscous, salty fluid ⇨ keep the body cool
  - proteins, water, sodium chloride, urea, uric acid

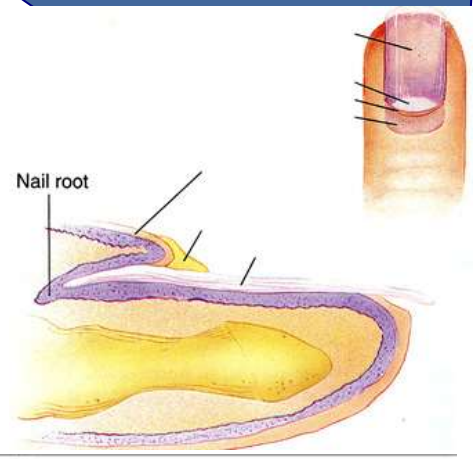


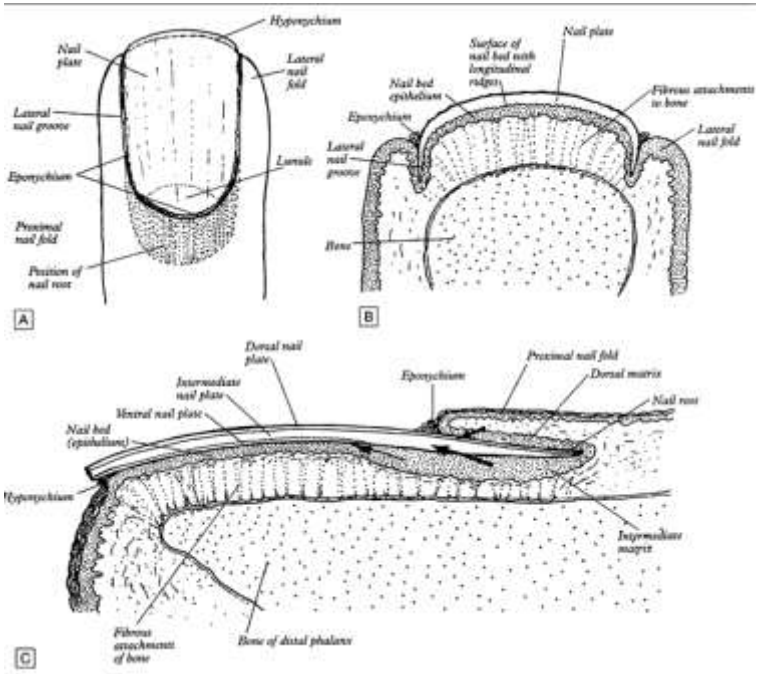


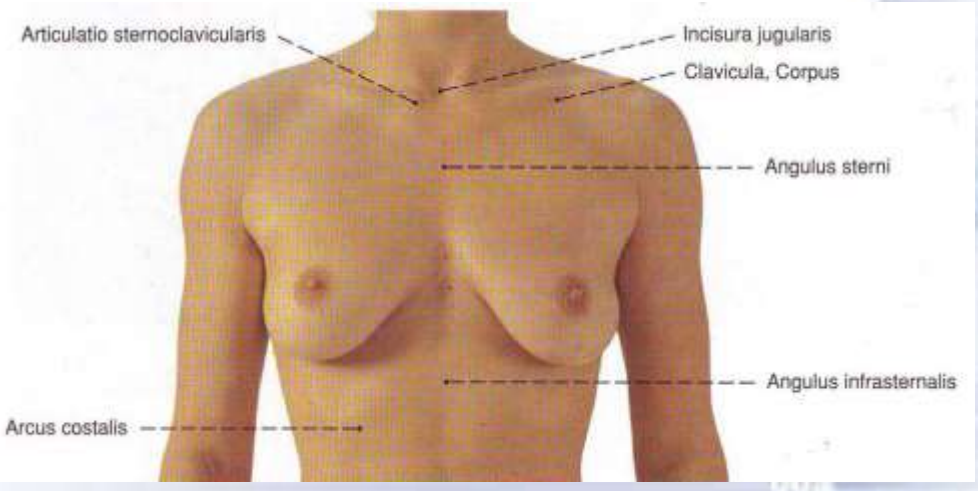
Nails

- Lat. *ungues*, Gr. *onyx, onychos*
- **fingernails** and **toenails –**
  on the dorsal surface of each distal phalanx:
  - ✓ tough keratin
    as animals' **hooves and horns**
- **nail parts:**
  - ✓ root – proximal part
  - ✓ body – exposed part
  - ✓ free border – distal end
- **structure:**
  - ✓ **matrix** – the only living part of the nail
  - ✓ **eponychium (cuticle)**
  - ✓ **paronychium** – the 'live' skin
  - ✓ **hyponychium**
  - ✓ **nail plate** – layers of keratin
  - ✓ **nail bad** – pink colour of the nail
  - ✓ **lunula** – visible whitish crescent part of the matrix
- **nail fold** – overlaps the base and sides of nails
- **nail groove** – guide the direction of nail growth









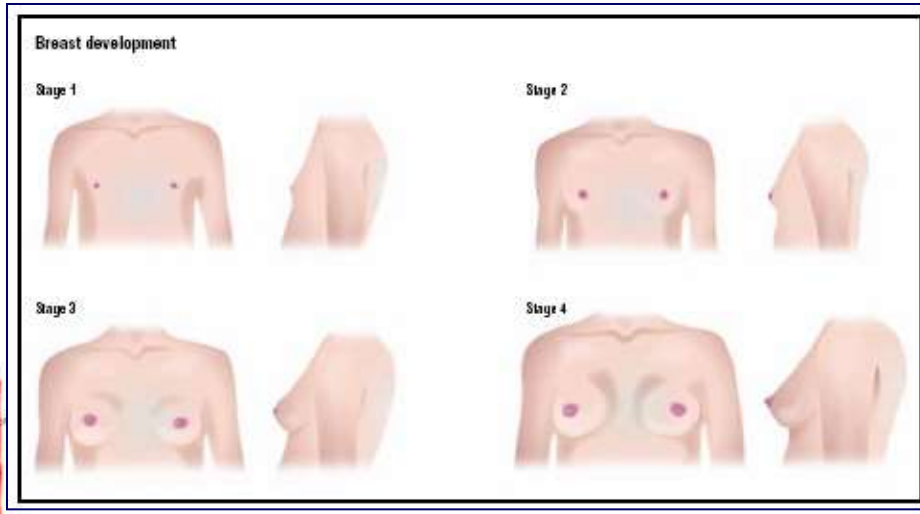
Femal mamma, breast

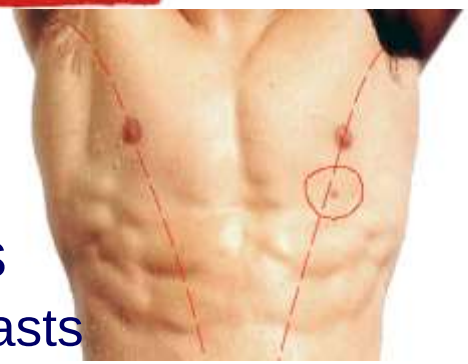
1. Embryonic development
2. Functional morphology
3. Blood supply
4. Lymphatic drainage
5. Innervation

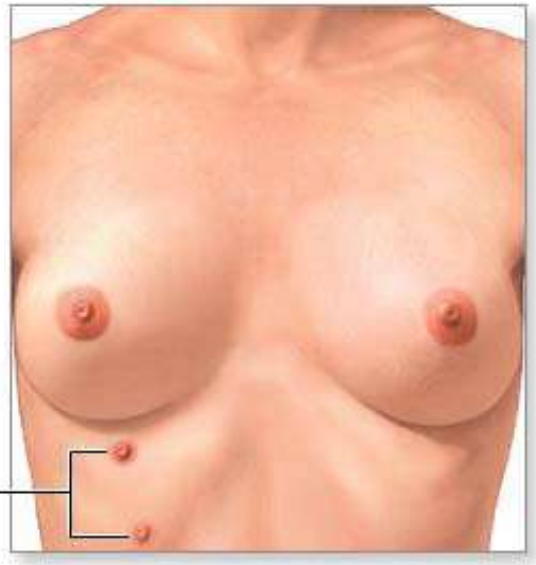
Embryonic development

- modified sudoriferous glands
- begin – fourth week of gestation, growth of a basic milk streak
- formation of milk lines, "ventral epidermal ridges" – sixth week of the embryo's "life"
- embryonic origin:
  - ✓ ectodermal – parenchyma ⇨ mammary papilla (nipple), alveoli, lactiferous ducts
  - ✓ mesenchymal – stroma ⇨ adipose tissue
- persist of mammary ridges ⇨ *polymastia* (accessory breasts along the milk line from axillae to groin)

polythelia (supernumerary nipple)







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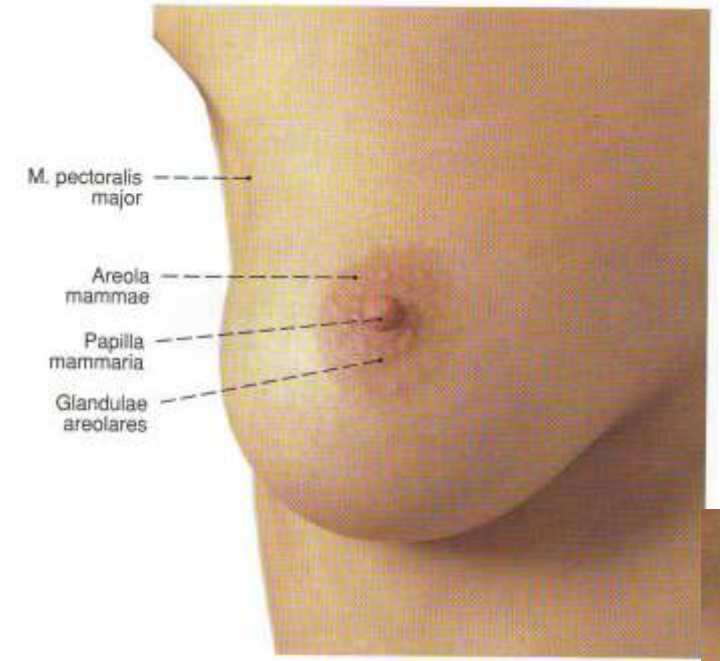
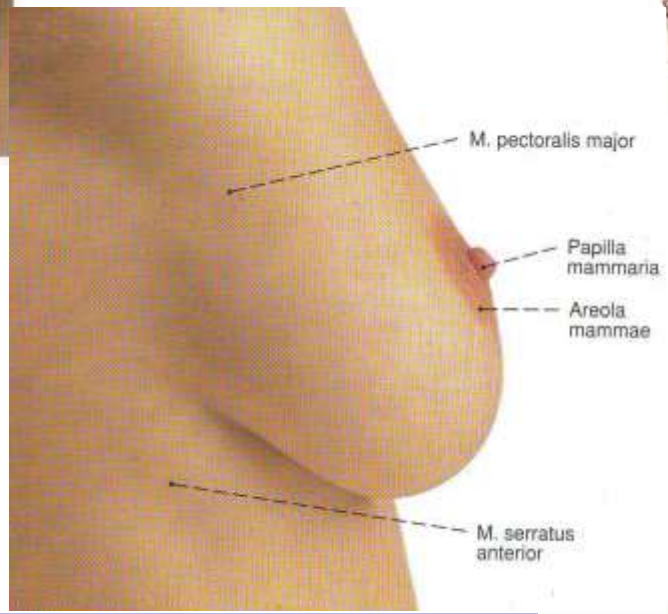
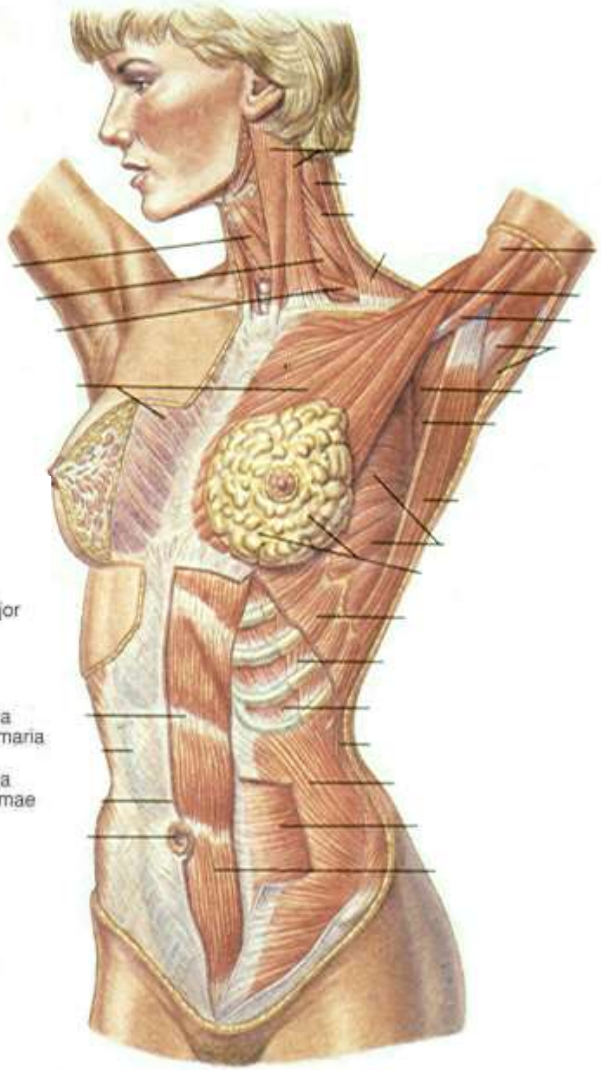
Artemis of Ephesus with tier upon tier of breasts to highlight her ability to nurture

Topographic and macroscopic anatomy

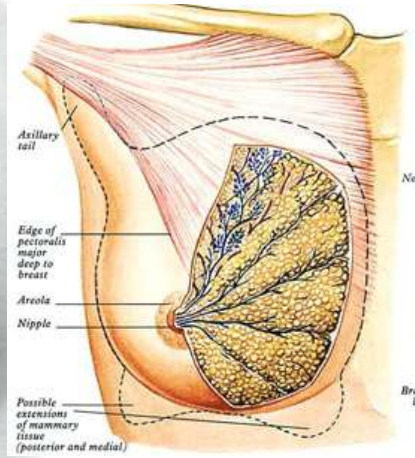


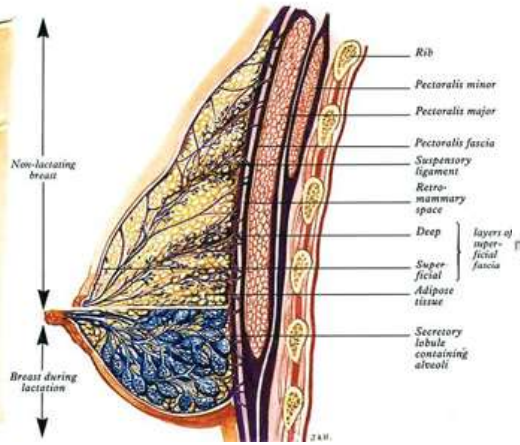


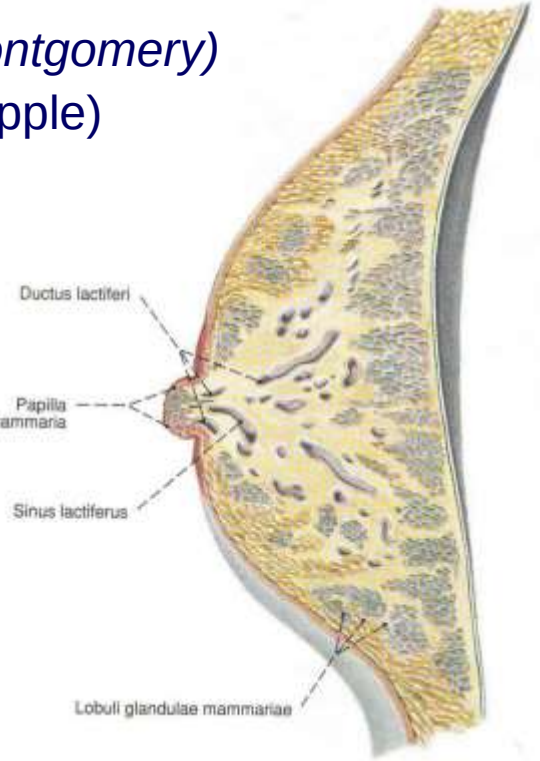


Adult breast anatomy

- *areola mammae:*
  - ✓ areolar glands *(of Montgomery)*
  - ✓ *papilla mammaria* (nipple)



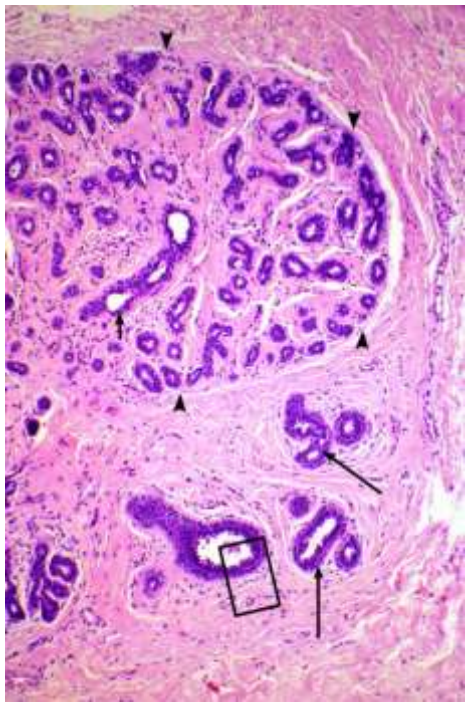


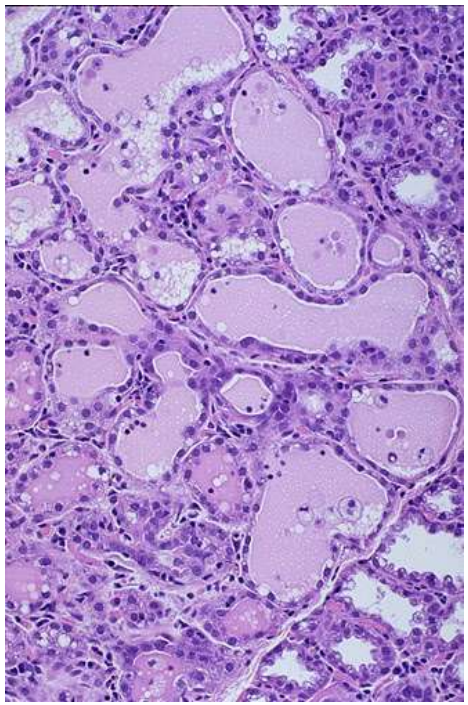


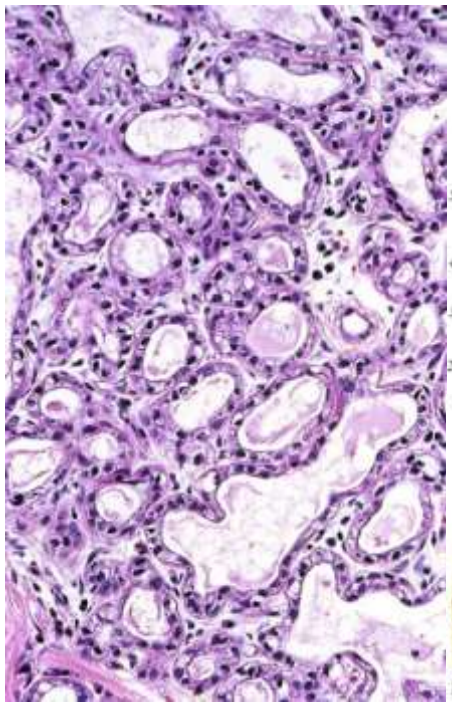
- *parenchyma mammae* – glandular tissue of the tubuloalveolar type
  - ✓ 15-20 lobes, *lobi glandulae mammariae:*
    - ➢ cluster of rounded alveoli – alveolar and myoepithelial cells
    - ➢ ducts and ductules – *ductus lactiferus, sinus lactiferus, porus lactiferus*
- *stroma mammae* – fibrous and adipose (fatty) tissue
  - ✓ *suspensory ligaments* (of *Cooper*)

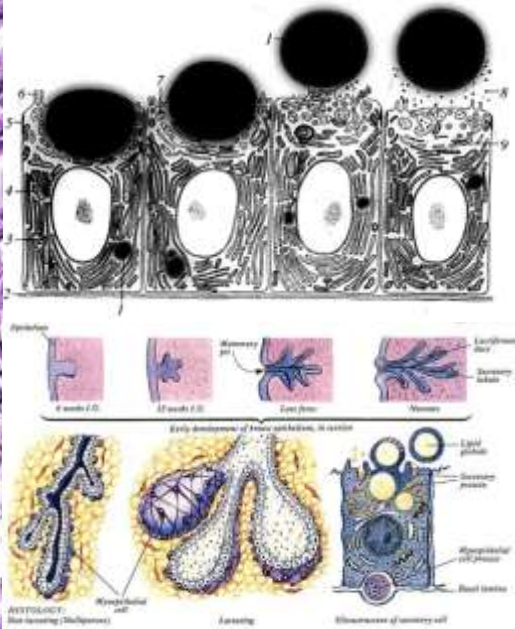
NB: The ratio of glands to adipose tissues rises from 1:1 in nonlactating women to 2:1 in lactating women!

Microscopic structure

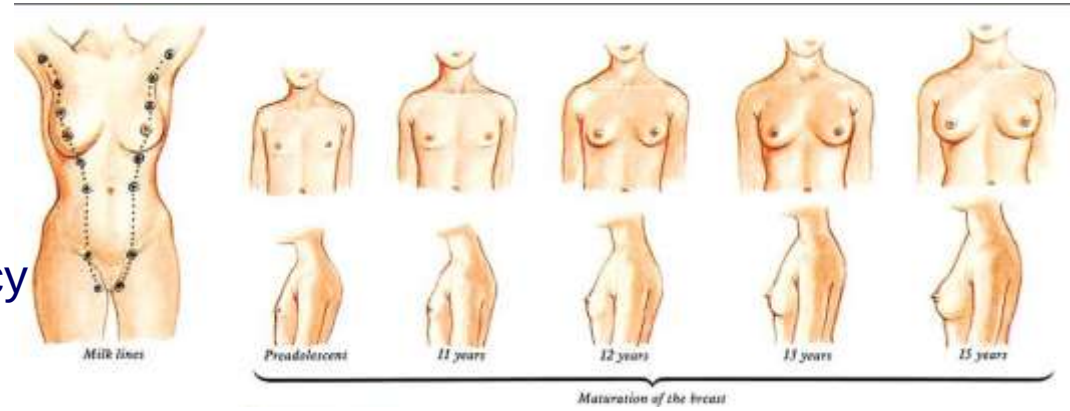




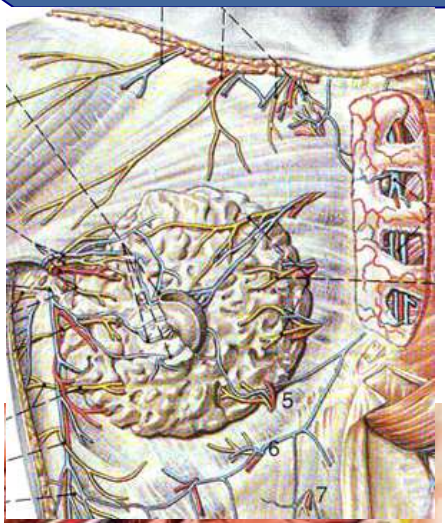


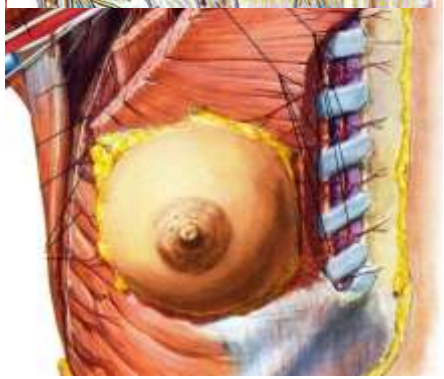


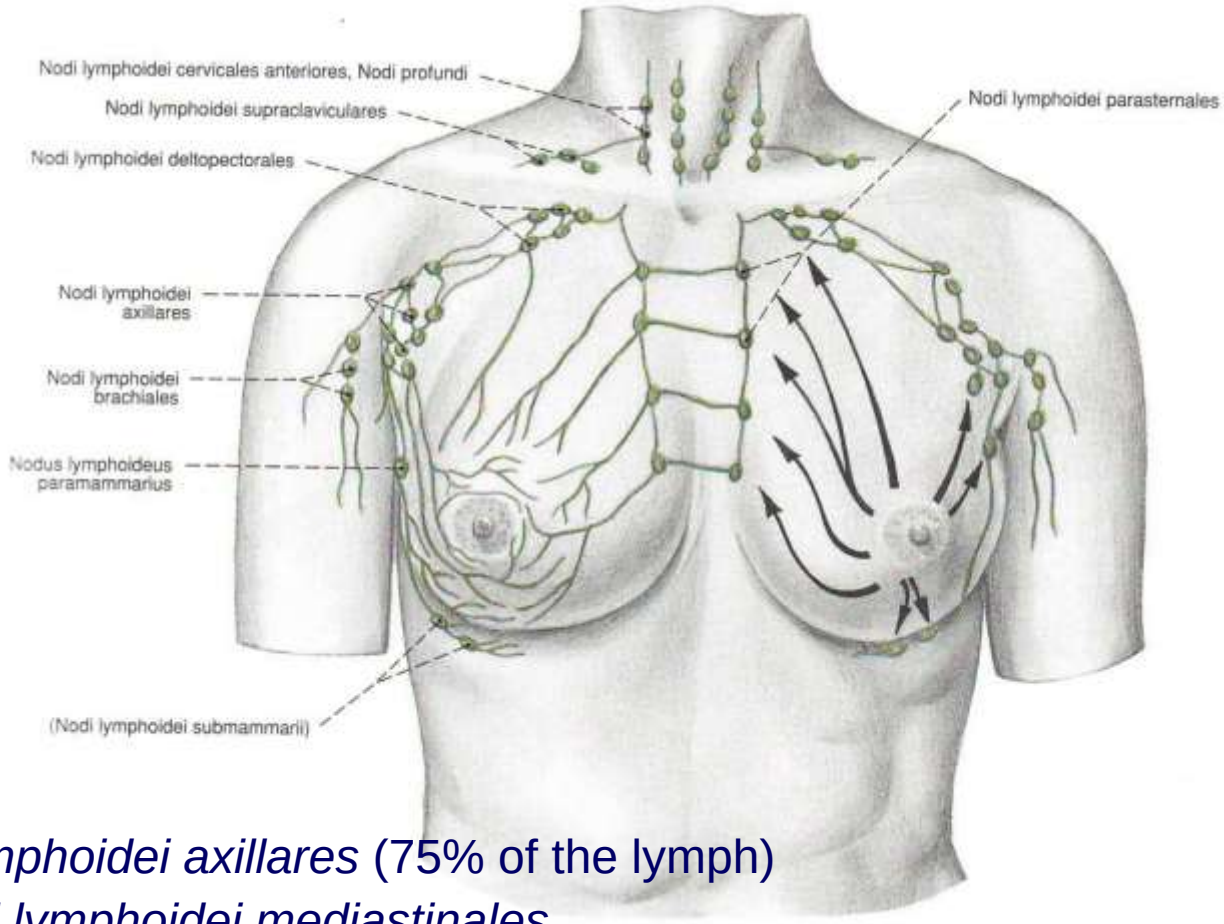
- functional stages:
  - ✓ childish breast (before puberty)
  - ✓ juvenile breast
  - ✓ adult resting mammary gland
  - ✓ mammary gland during pregnancy
  - ✓ lactating mammary gland



Blood vessels and lymphatic drainage

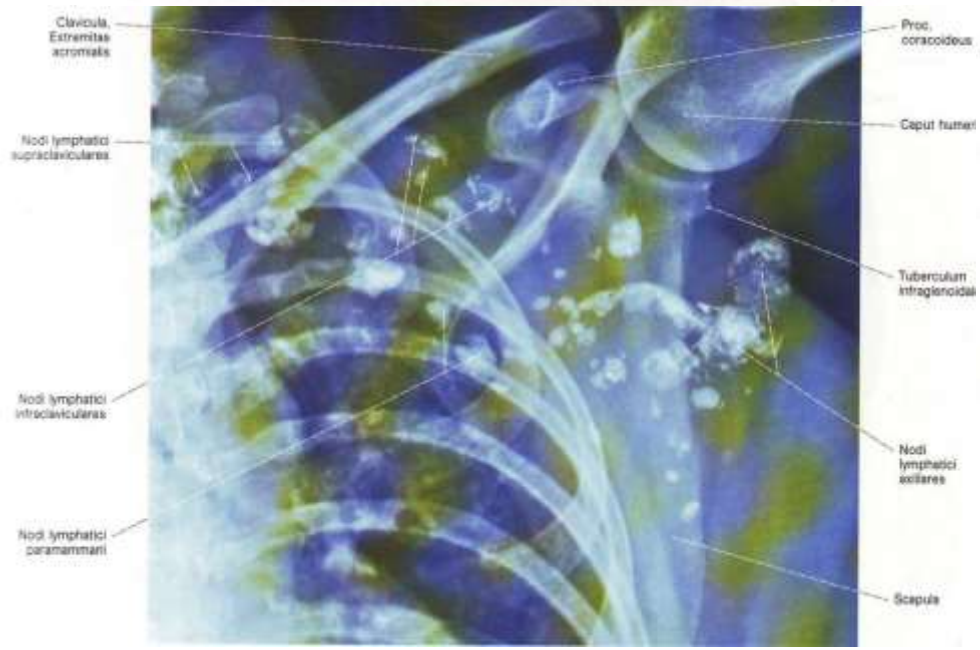


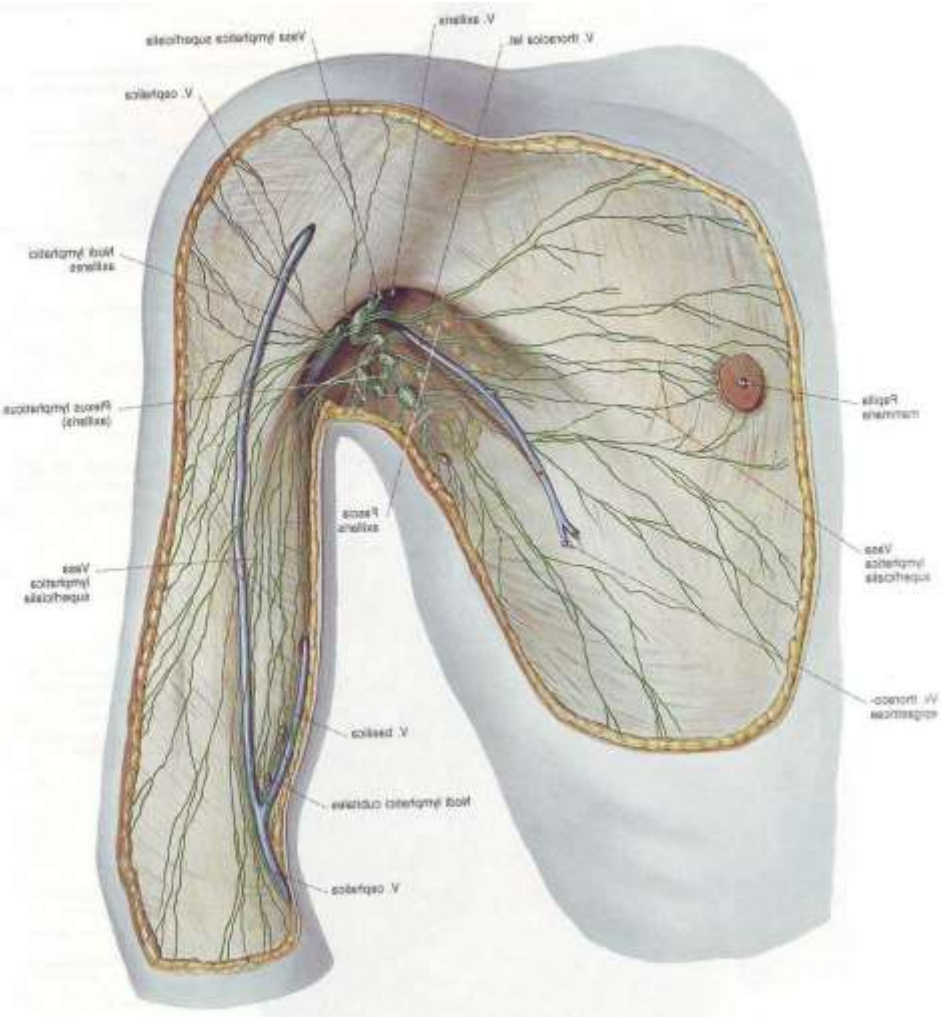




- superficial plexus ⇨ *nodi lymphoidei axillares* (75% of the lymph)
- deep (fascial) plexus ⇨ *nodi lymphoidei mediastinales*
  - ✓ lymphatic pathway of *Grossman* ⇨ *nodi lymphoidei apicales (infraclaviculares)*
  - ✓ lymphatic pathway of *Gerota* ⇨ *nodi lymphoidei hepatici et subdiaphragmatici*

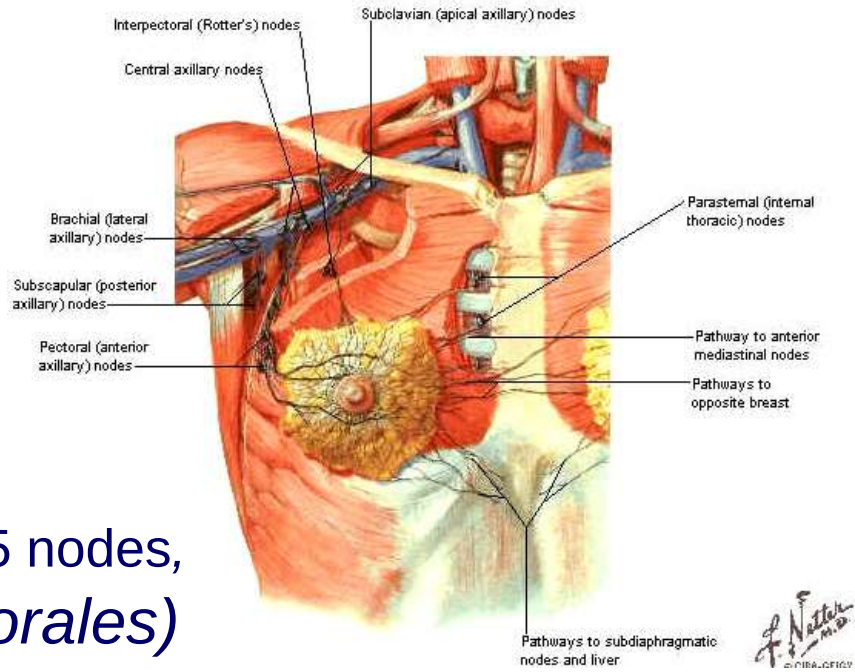
Lymphatic drainage

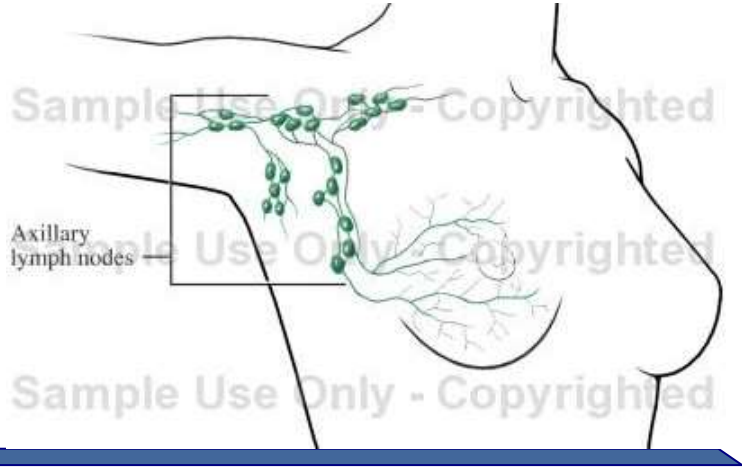




Axillary lymph nodes

- 5 groups (20-40 nodes):
  - ✓ **apical group** – 6-12 nodes, *nodi lymphatici apicales (infraclaviculares)*
  - ✓ **central group** – 4-6 nodes, *nodi lymphatici centrales*
  - ✓ **anterior (pectoral) group** – 4-5 nodes, *nodi lymphatici mediales (pectorales)*
  - ✓ **posterior (subscapular) group** – 6-7 nodes, *nodi lymphatici subscapulares*
  - ✓ **lateral group** – 3-8 nodes, *nodi lymphatici laterales*

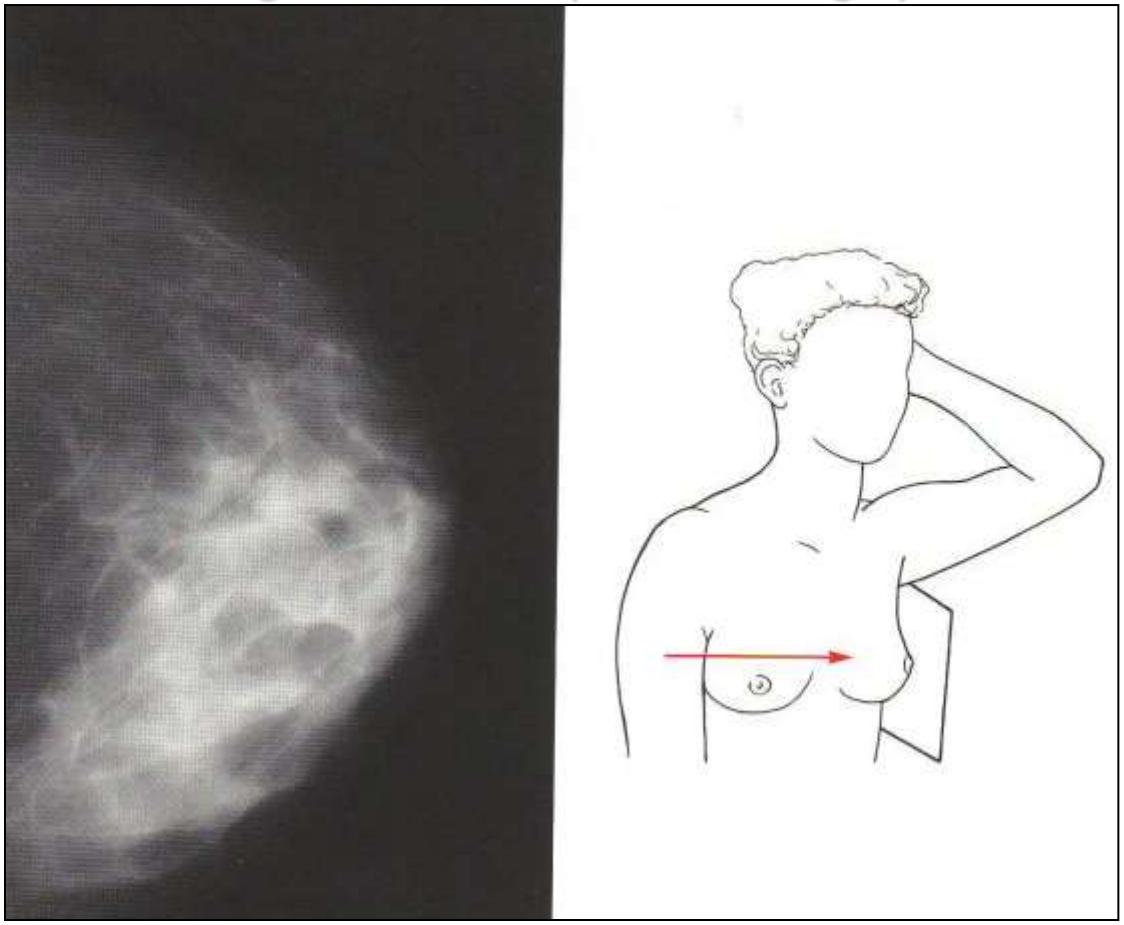




Clinical significance

Breast cancer

Paget's disease *(morbus Paget)* – a special type of ductal carcinoma

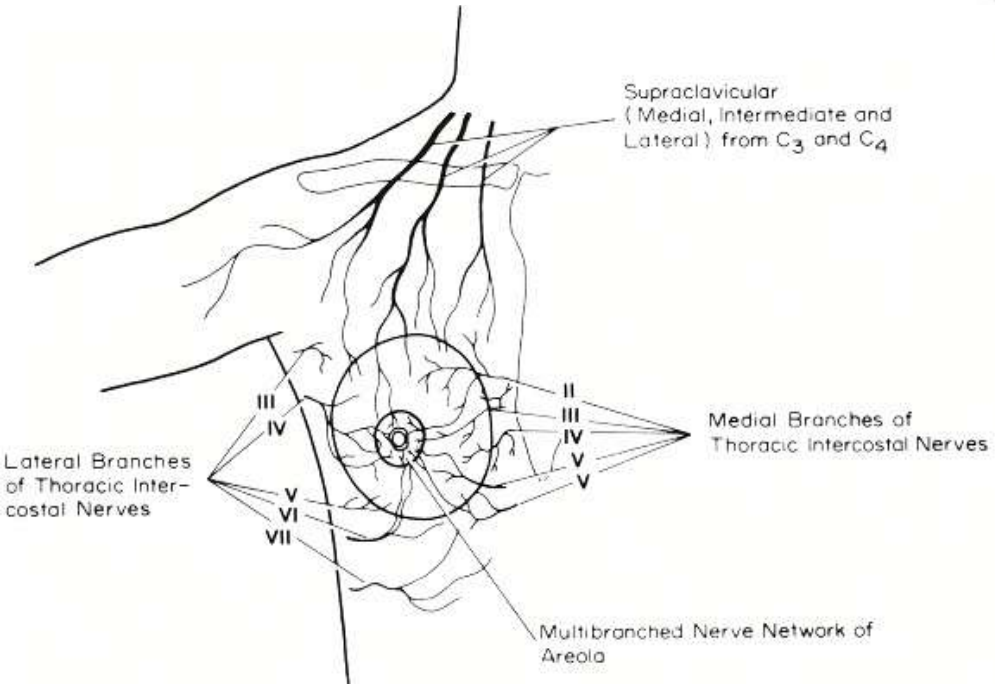


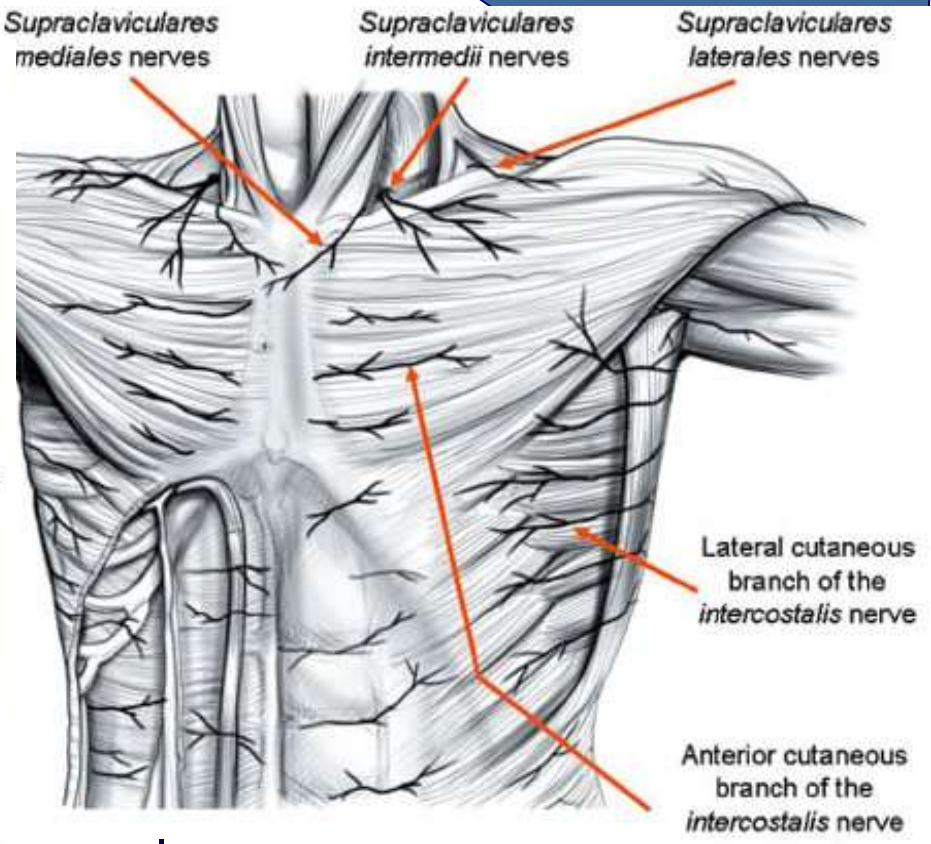
Mammography

Gynecomastia

Gr. *γυνή gyne*, "woman" and *μαστός mastos*, "breast"

Breast innervation





- sympathetic fibers ⇨ along the blood vessels
- sensory fibers ⇨ *rami glandulares of rami perforantes* of the intercostal nerves
  - ✓ *rr. mammarii mediales* ⇨ *rr. cutanei anteriores* II-VI intercostal nerve
  - ✓ *rr. mammarii laterales* ⇨ *rr. cutanei lateralis* IV-VI intercostal nerve

Thank you…


GUINNESS
WORLD RECORDS
CERTIFICATE
Maxi Mounds (USA) was measured at Sarasota, Florida, USA, on 4 February 2005 and found to have an under breast measurement of 91.44 cm (36 in) and an around chest-over-nipple measurement of 153.67 cm (60.5 in). She currently wears a US size 42M bra (UK 42J)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