

# PLANES AND DIRECTION OF THE BODY GENERAL OSTEOLOGY SKELETON OF THE SPINE AND THORAX

1. Lecture, DENTISTRY AUTUMN 2015

Lecturer: RNDr. MICHAELA RAČANSKÁ, Ph.D.

# Syllabus

Lectures: We 13,20-15,00

Seminars: We 15,40- 17,20 MUDr. Roman Kopáček

## ANATOMY 1 Dentistry- autumn 2015

	Date	Lectures	Seminars
1.	23. 10.	Planes and direction of the body. General osteology Skeleton of the spine and thorax	Planes and direction of the body. X-Ray - anatomy Skeleton of the spine and the thorax
2.	30. 9.	Skeleton of the upper extremity	Skeleton of the upper extremity
3.	7. 10.	Skeleton of the lower extremity	Skeleton of the lower extremity
4.	14. 10.	Neurocranium	Neurocranium
5.	21. 10.	Splanchnocranium	Splanchnocranium
6.	28. 10.	Cavities of the skull	Cavities of the skull
7.	4. 11.	General arthrology Joints of the spine and thorax	General arthrology Joints of the spine and thorax
8.	11. 11.	Joints of the skull and upper extremity	Joints of the skull and upper extremity
9.	18. 11.	Joints of the lower extremity. Pelvis	Joints of the lower extremity. The pelvis
10.	25. 11.	General myology. Muscles and fasciae of the head.	<b>Control examination (osteology, arthrology)</b>
11.	2. 12.	The muscles of the neck, thorax, back	
12.	9. 12.	Muscles of the upper limb	
13.	16. 12.	Muscles of the lower limb	
14.	6. 1.	Muscles of the abdomen	Muscles – overview

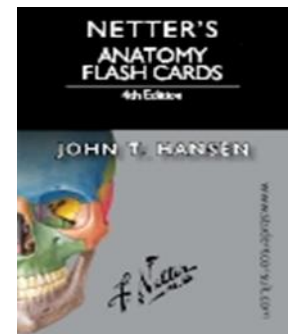
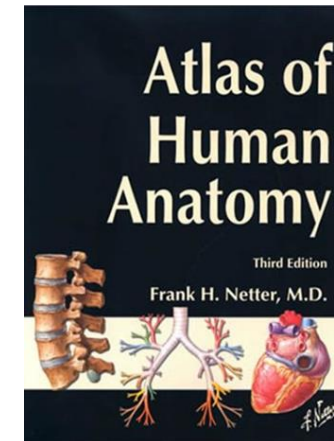
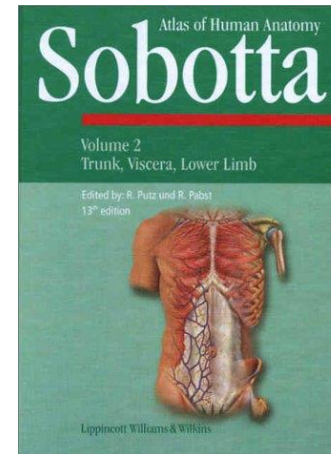
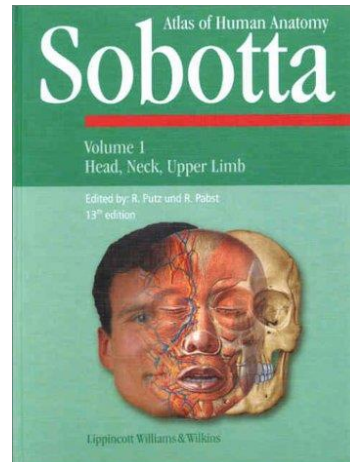
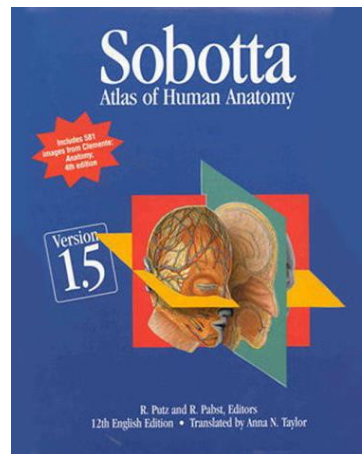
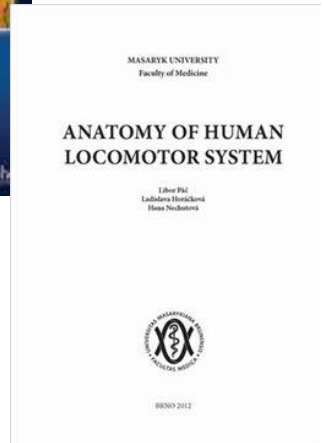
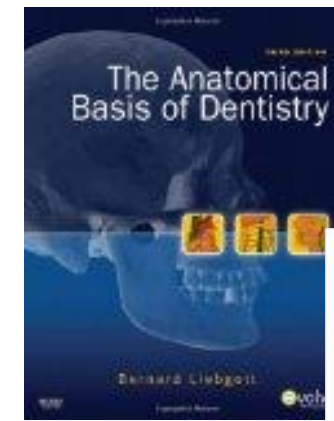
# Where you can study from?

Liebgoth, Bernard. *The anatomical basis of dentistry*. 3rd ed. Mosby, ISBN 0-323-06807-3

PÁČ, Libor, Ladislava HORÁČKOVÁ a Hana NECHUTOVÁ. *Anatomy of human locomotor system*. 1. vyd. Brno: Masarykova univerzita Brno, 2010. 119 s. ISBN 978-80-210-5258-1.

*Atlas of human anatomy*. Edited by Johannes Sobotta - Reinhard Putz - Reinhard Pabst - Renate Putz. 13th English ed., 21st Germa. Philadelphia: Lippincott Williams & Wilkins, 2001. 404 s. ISBN 0-7817-3174-7.

NETTER, Frank H. *Atlas of human anatomy*. 4th ed. Philadelphia: Saunders Elsevier, 2006. 548 color. ISBN 1-4160-3385-8.



# Anatomical nomenclature

## Terminologia Anatomica – International Anatomical terminology (FCAT) 1998

- Anatomy is the basis of the language of medicine. Students learn a new language consisting of at least 4500 words. International.
- Many anatomical terms are derived from Latin and Greek.
  
- To describe the relationship of one structure to another, the anatomical nomenclature should be used.
- To be understood you must express yourself clearly, using the official terms in the correct way.
  
- 1. Andreas Vesálius, founder of the modern anatomy, 16. century.
- 2. Basiliensia Nomina Anatomica, B. N. A.,  
1895
- 3. Ienaiensia Nomina Anatomica, I. N. A.,  
1935
- 4. Parisiensia Nomina Anatomica, P. N. A.,  
1955 accepted 1960, last corrections - 1985 (5640 terms)

## Anatomical nomenclature

The **first word is name of described formation**,  
**next adjectives specificate it**  
**and in the end there is a name of formation where the described formation is located**.

Examples:

**Collum** (neck) **radii** (of radius)

**Collum** (a neck) **anatomicum** (anatomical) **humeri** (of humerus)

**Collum** (a neck) **chirurgicum** (surgical) **humeri** (of humerus)

**Tuberculum** (a tubercle, a bulge) **majus** (big) **humeri** (of humerus)

**Spina** (a thorn) **iliaca** (iliac) **anterior** (fore) **superior** (upper) **ossis coxae** (of coxal bone)

**Epicondylus medialis humeri**

**Epicondylus medialis femoris**



# Orientation on the body



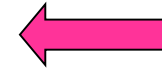
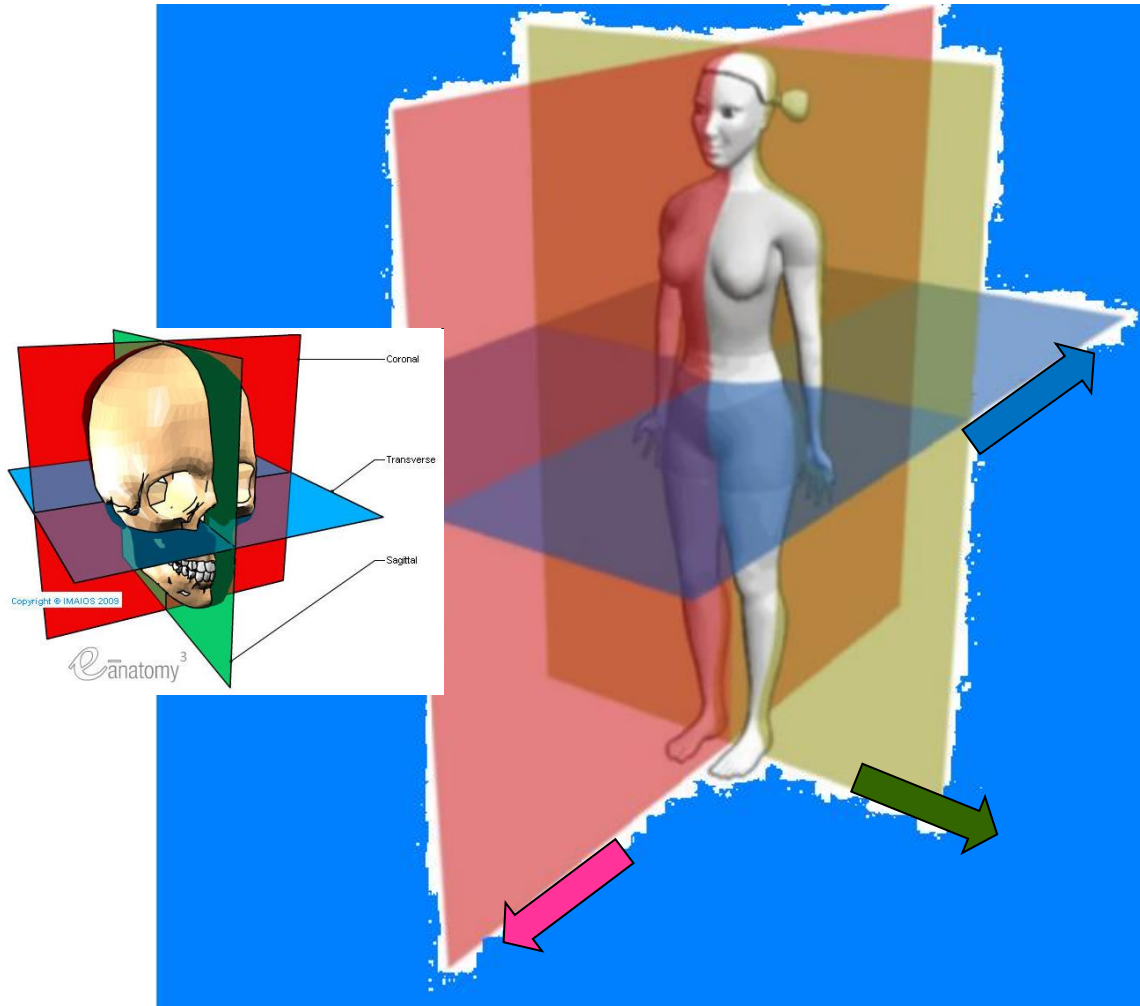
Anatomical position  
standard erect position

X



**Not a military position!**

# PLANES – 3 anatomical planes or sections



Sagittal plane (median),  
Midsagittal  
vertical plane - Right and left  
Acc. to sagittal axis



Transverse plane (horizontal, axial, cross sections)  
Vertical plane - Superior and inferior  
(acc. to transversal axis)



Frontal plane (coronal)  
Anterior and posterior  
(acc. to longitudinal axis)

# Directions on the body



→ cranialis

☺ superior

→ ventralis

☺ anterior

→ medialis

☺ medianus

☺ dexter

● superficilais

☺ internus

→ caudalis

☹ inferior

→ dorsalis

☹ posterior

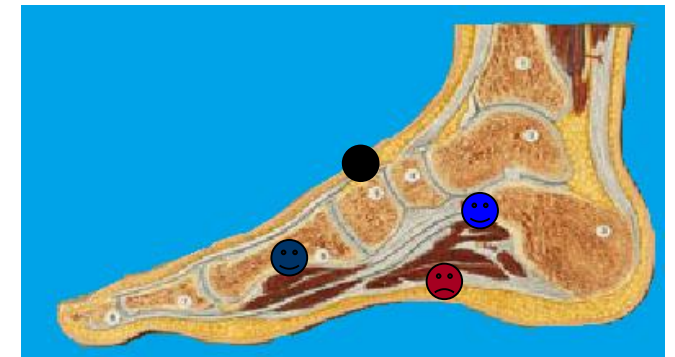
→ lateralis

☹ medius (intermedius)

☹ sinister

☹ profundus

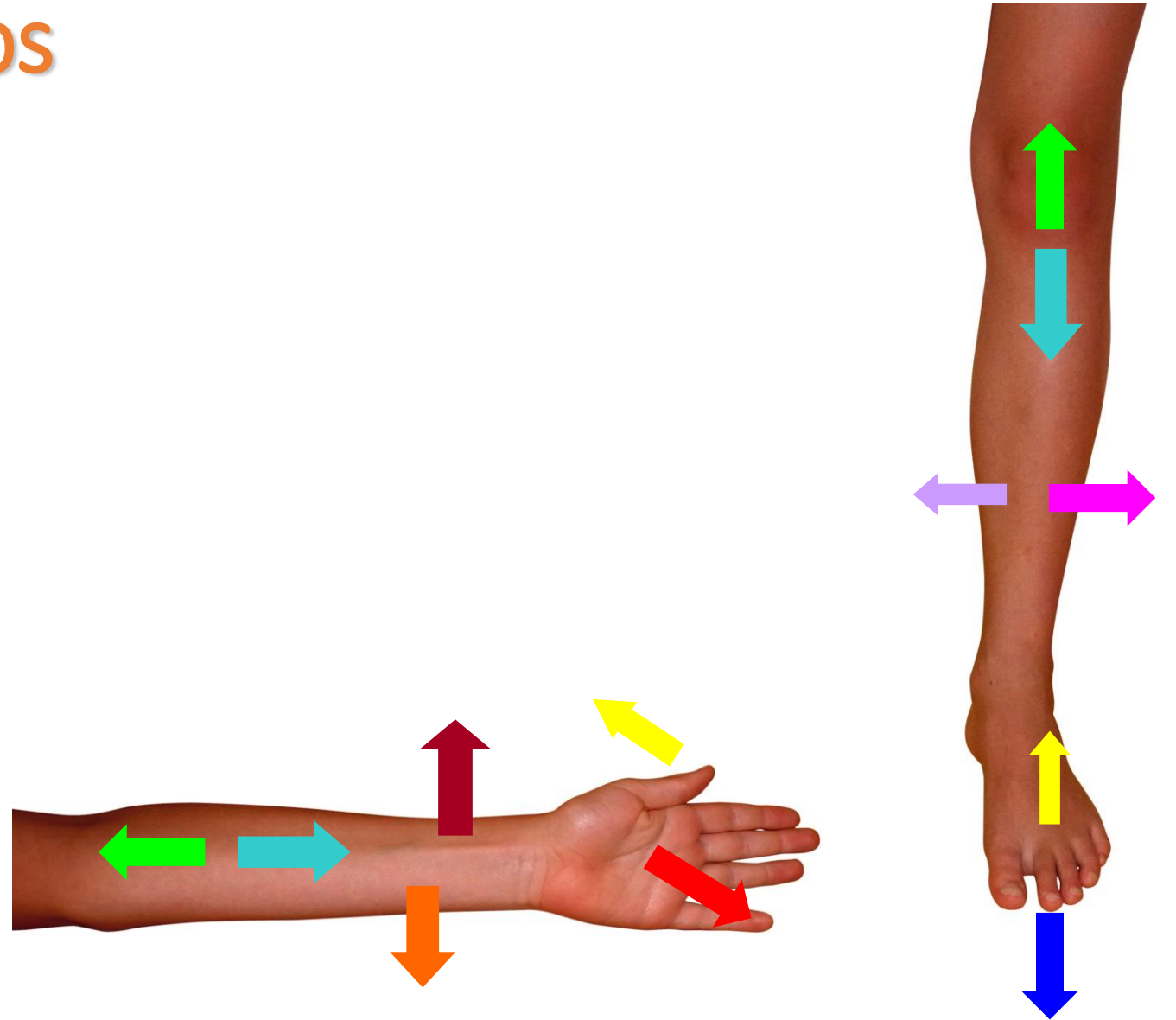
☹ externus





# Directions at the limbs

- PROXIMALIS
- DISTALIS
- RADIALIS (lateralis)
- ULNARIS (medialis)
- PALMARIS
- DORSALIS
- PLANTARIS
- FIBULARIS (lateralis)
- TIBIALIS (medialis)



# Marking of bones -positive and negative relief

## NEGATIVE

- Sulcus – a groove
- Incisura – a notch
- Canalis – a canal
- Fossa – a pit, hollow
- Fovea – a pit, hollow
- Foramen – an opening, orifice, gap
- Groove – a furrow

## POSITIVE

- Processus – a projection, prominence
- Spina – a thorn
- Tuberculum – a tubercle
- Tuber – a torus
- Tuberositas – a tuberosity, large rounded eminence

Internus – internal

Externus – external

Superficialis – superficial

Profundus – deep

Caput – a head

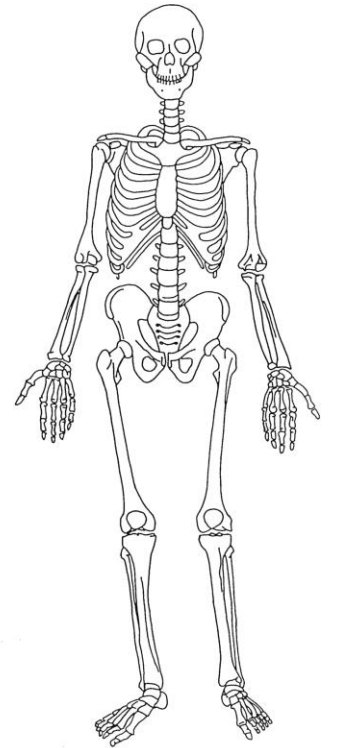
Capitulum – a small head

Collum, cervix – a neck

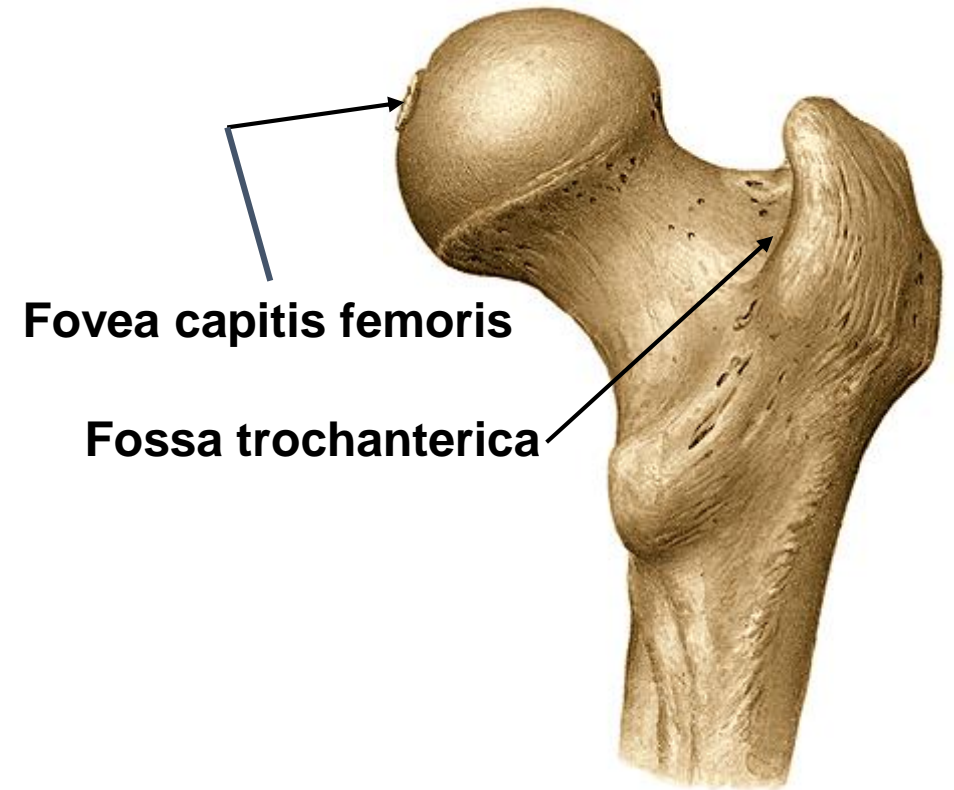
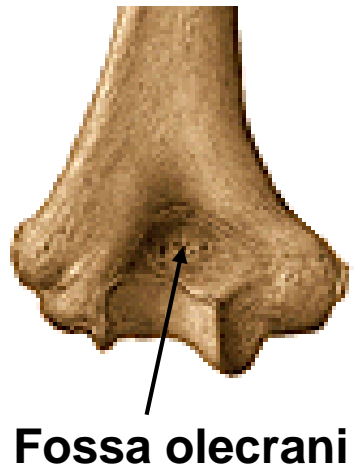
Os, ossis, ossa – a bone, bones

Articulus – a joint

Facies – a facet, surface



# Fossa x fovea



# Caput x condylus

**Caput humeri**



**Epicondylus med. et lat. humeri**

**Caput tali**



**Caput femoris**



**Condylus medialis  
et lateralis**

**et epicondylus med. et lat. femoris**

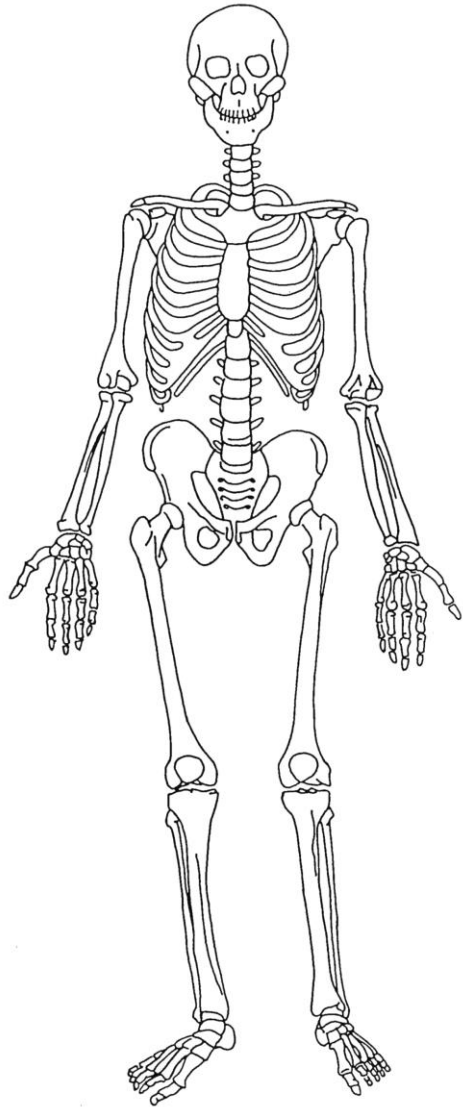
# Incisura x foramen

**Incisura scapulae**



**Foramen obturatum**





# General osteology

- The skeleton is composed of a living, dynamic, rigid, connective tissue that forms bones and cartilages
- In total 214 (incl. sesamoid bones), it varies
- Cartilage at the places where flexibility is important, or covers articulation surfaces

## FUNCTION OF SKELETAL SYSTEM

- Support
- Protection of vital organs
- Together with muscles a mechanism for movement
- Storage of calcium (99% of body's calcium is stored in bone) and other salts
- A source of blood cells (Bone marrow in the central cavity, hemopoetic (blood-forming) cells)

# Basic structure of bones

- Bone as a connective tissue consists of :
  - bone cells (**osteocytes**)
  - Ground substance+ collagenous fibrils form - **osteoid** (ossein) – organic material
  - Different salts – hardness and strength – anorganic material

A salt free or decalcified bone is pliable

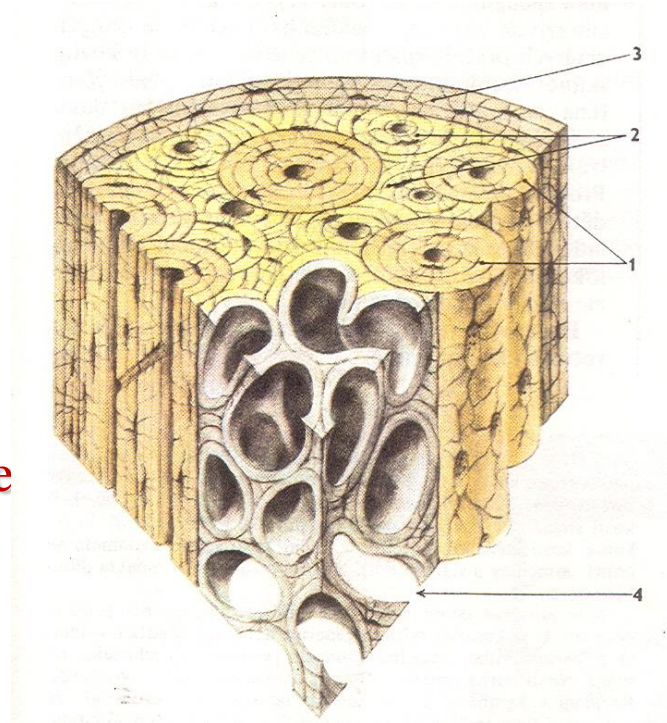
- in young 52% of organic component
- In elderly 40 %



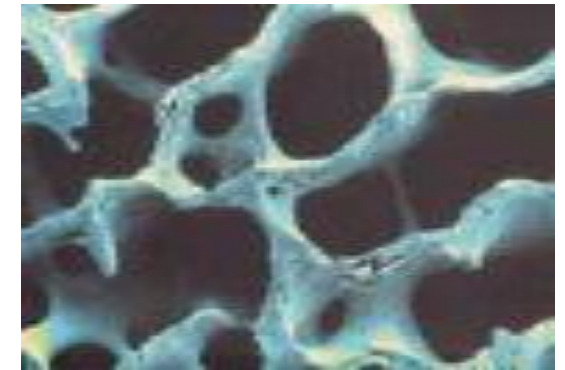
## TYPES OF BONE ACCORDING TO THE STRUCTURE

### 1) compact bone

A relatively solid mass of bone  
Commonly seen as a superficial layer  
of bone, that provides strenght

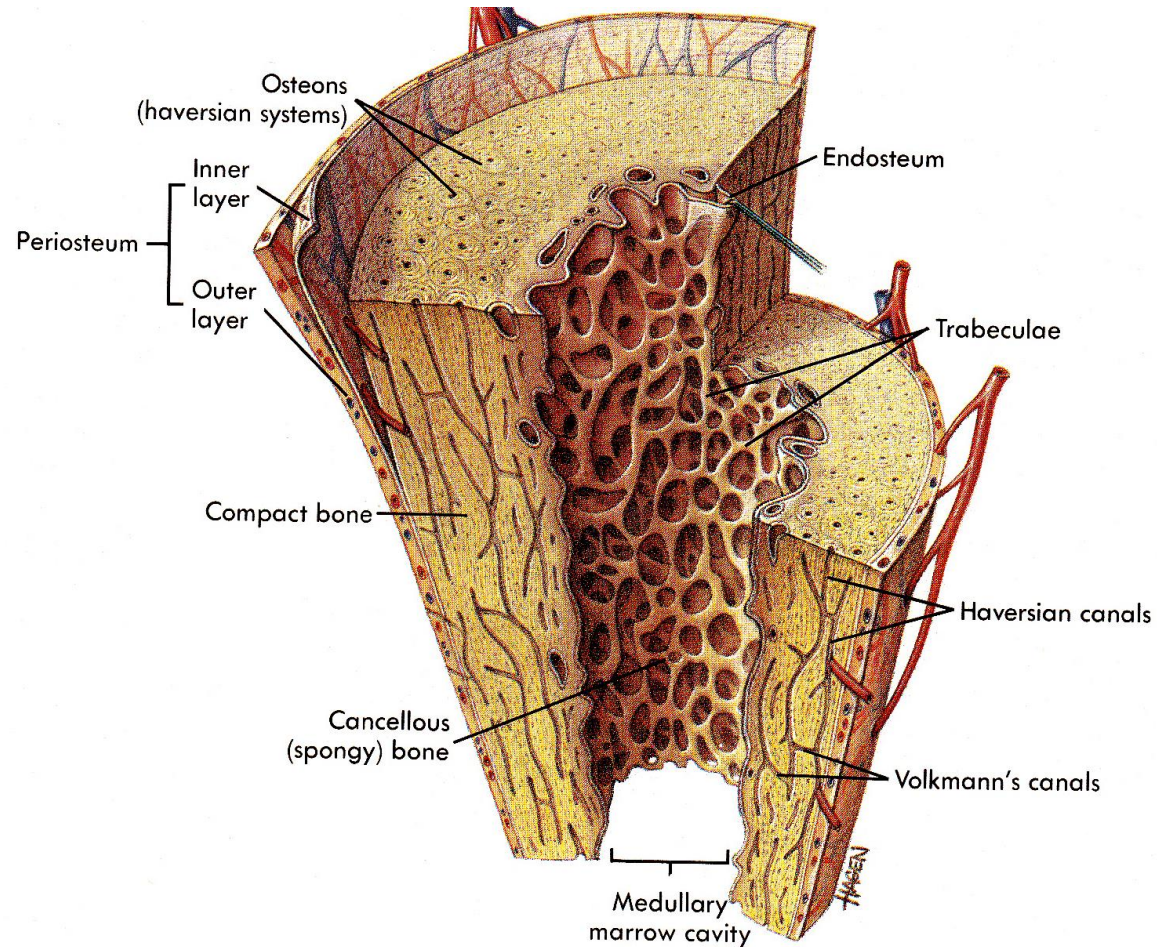


**2) spongy (trabecular or cancellous) bone**  
A less dense trabeculated network of bone  
spicules making up the substance of most  
bones, surrounding an inner marrow cavity,





# BONE STRUCTURE



## Periosteum

External fibrous

Internal cambious layer

(osteoblasts, Sharpey's fibers, remodelation

## Substantia compacta

## Substantia spongiosa

Bone architecture, trajectories



## Endosteum

Bone reconstruction, it is not possible to peel it off

## Cavitas medullaris

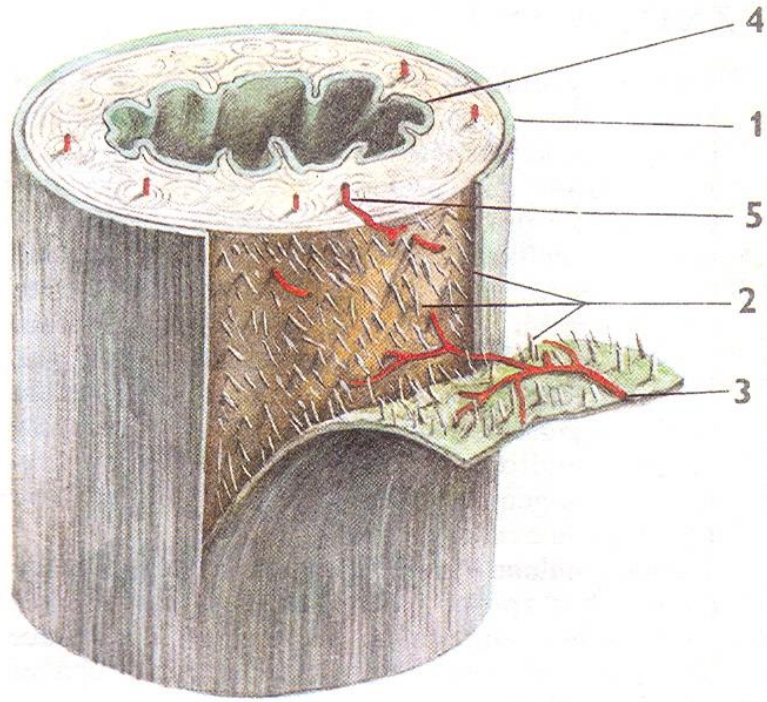
- (bone marrow)

medulla ossium rubra

medulla ossium flava

medulla ossium gelatinosa





- 1 – periosteum
- 2 – Sharpey's fibers
- 3 – vessels in a periosteum
- 4 – endosteum
- 5 – a vessel from periosteum passes through Volkmann's canal to vessels of Havers's systems

## Periosteum (periost)

covers almost all parts of the bone (not at the joint surfaces)

it contains many blood and lymph vessels and nerves.

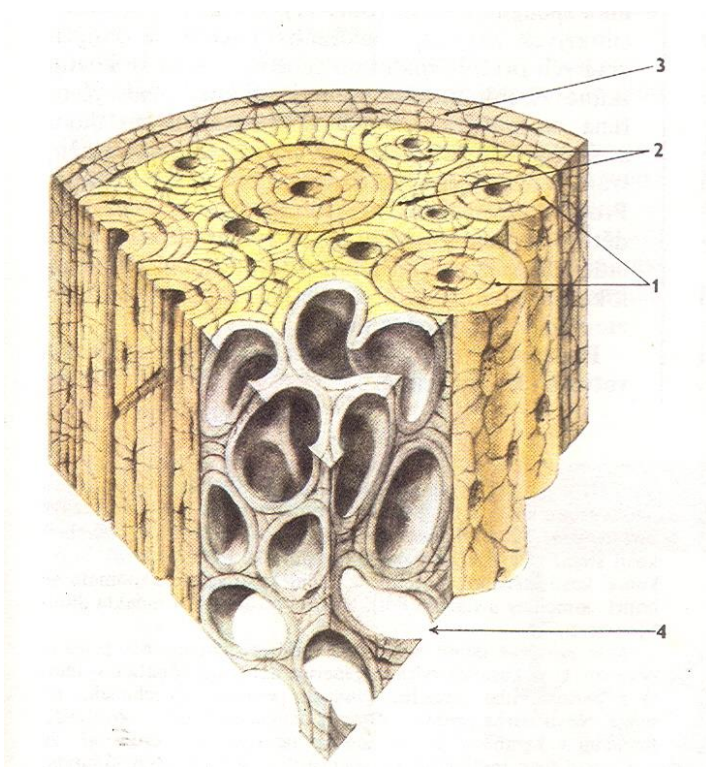
A bone from which the periosteum has been removed will die.

Periosteum consists of:

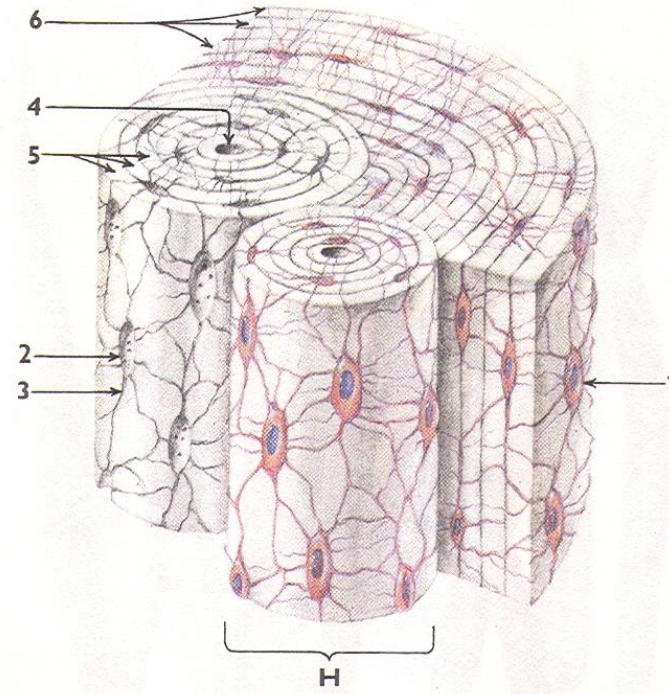
**a) a fibrous layer (external)**

**b) a cambious layer (the site of osteoblasts – built up bone and help of healing – fractures)**

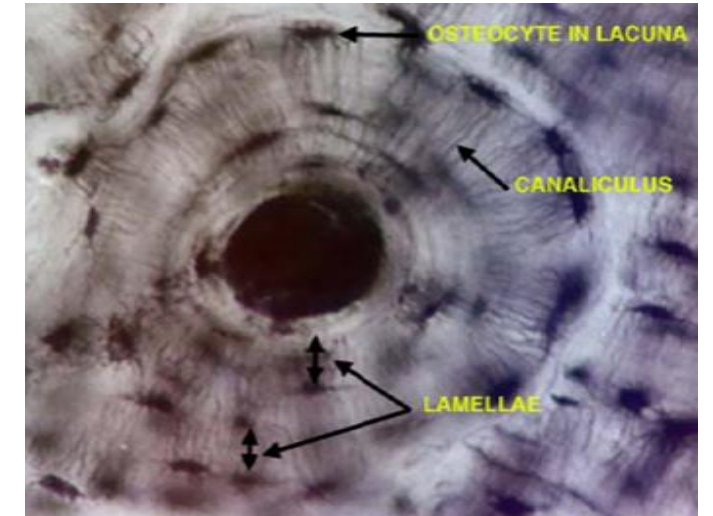
# Lamellar bone tissue

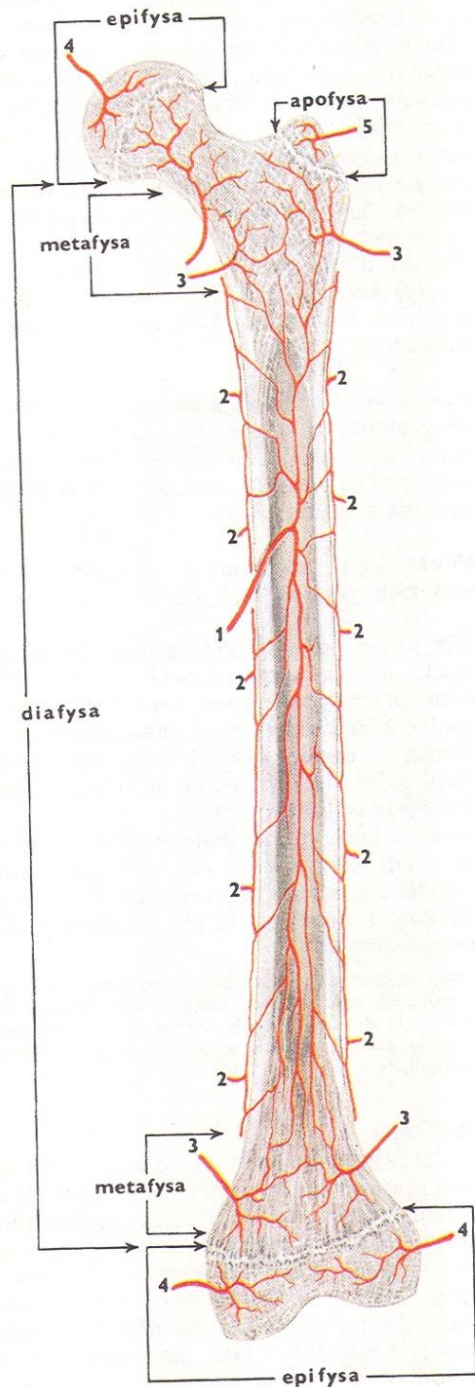


- 1 – Haversian lamellae
- 2 – interstitial lamellae
- 3 – superficial lamellae
- 4 – lamellae of spongy bone



- H – Haversian system of lamellae, osteon
- 1 – osteocyte
- 2 – lacuna
- 3 – canaliculus osseus
- 4 – Haversian canal of osteon
- 5 – concentric lamellae of osteon
- 6 – superficial lamellae





## BLOOD SUPPLY

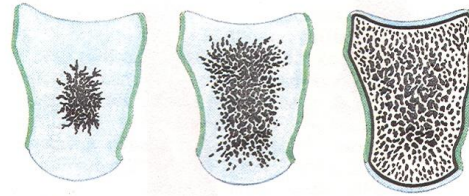
- Nutrient arteries (one or more, through the diaphysis)
- Periosteal arteries (supply the compact bone)
- Metaphyseal arteries
- Epiphyseal arteries
- Apophyseal arteries

# BONE DEVELOPMENT (ossification)

## 1) Intramembranous formation

Flat bones

Direct calcium deposition  
into mesenchymal model of the bone

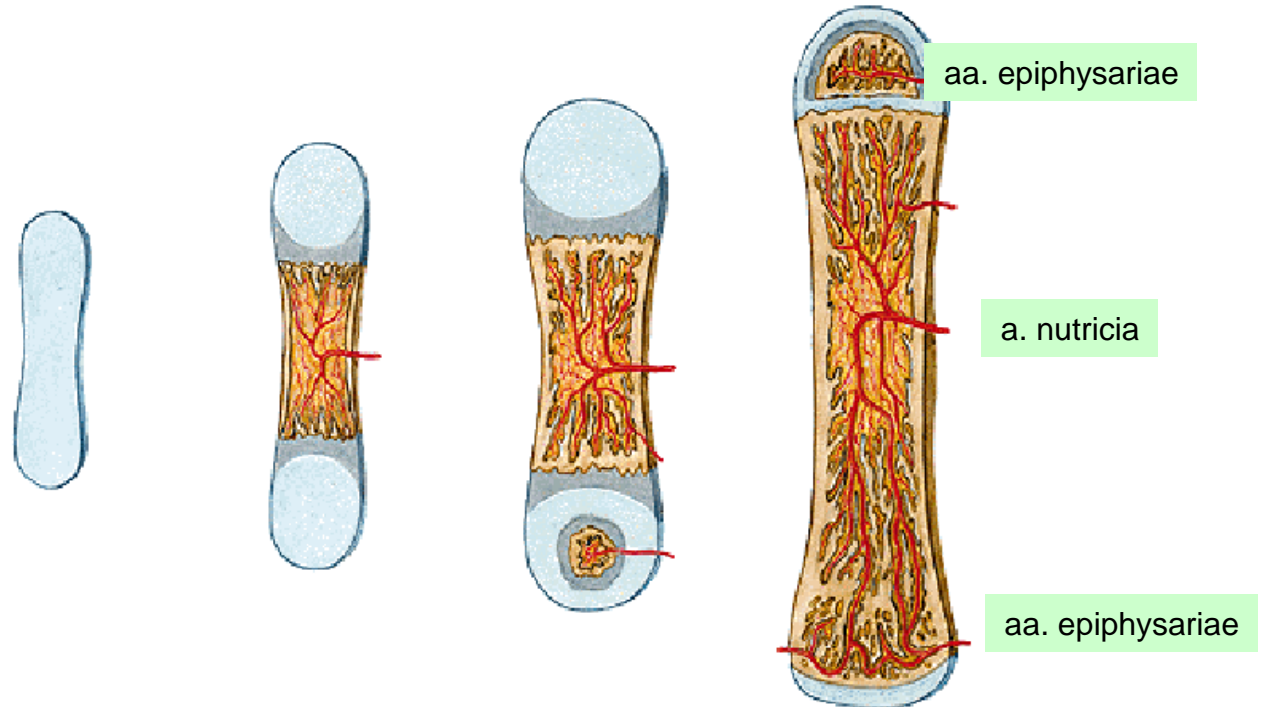


## 2) Endochondral formation

Long bones, irregular bones

Calcium deposition into a cartilaginous  
model of the bone

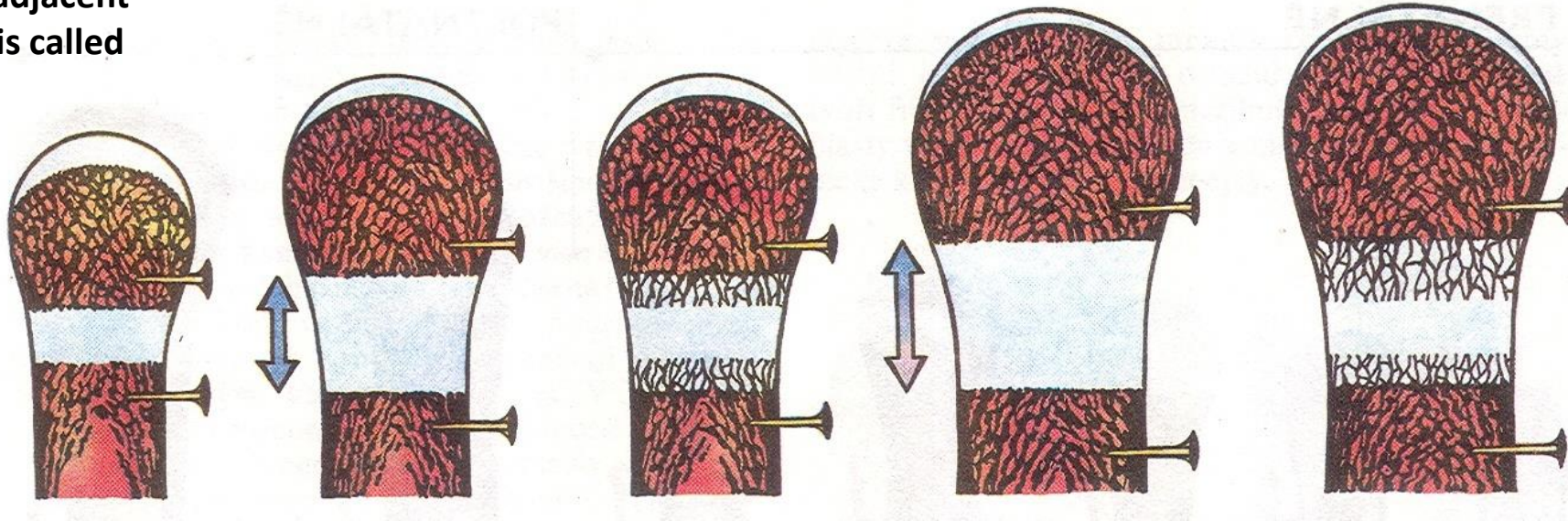
- a) perichondral  
originates in diaphysis
- b) enchondral  
in cartilage near epiphyses



Growth plate = epiphyseal disk  
is necessary for growth in length, forms a layer between  
the epiphysis and the diaphysis.

## Bone growth

The part of diaphysis adjacent  
to the epiphysial disk is called  
metaphysis.

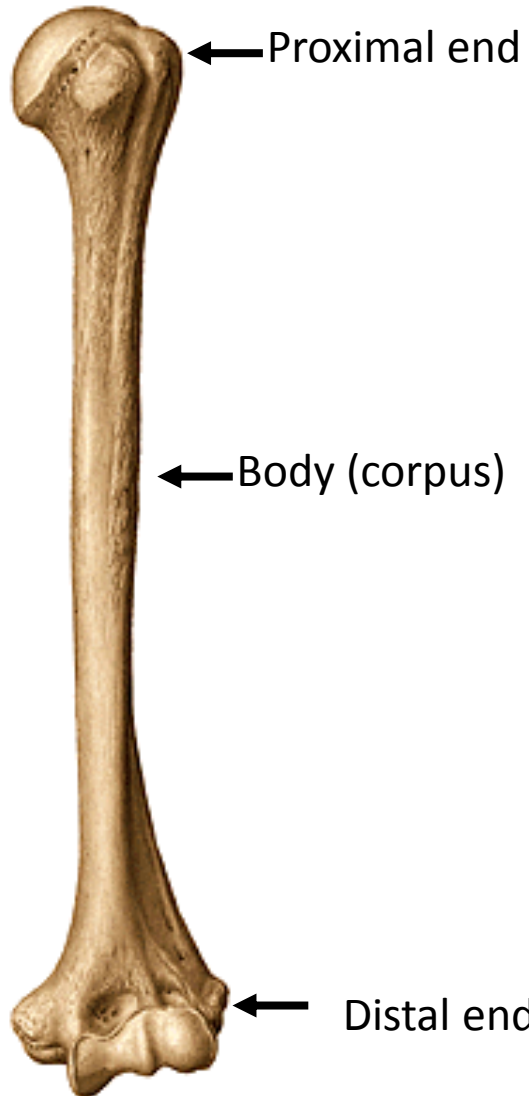


Growing of the **epiphyseal cartilage** followed by the ossification of both epiphysis and diaphysis  
as the background of growing into the **length**

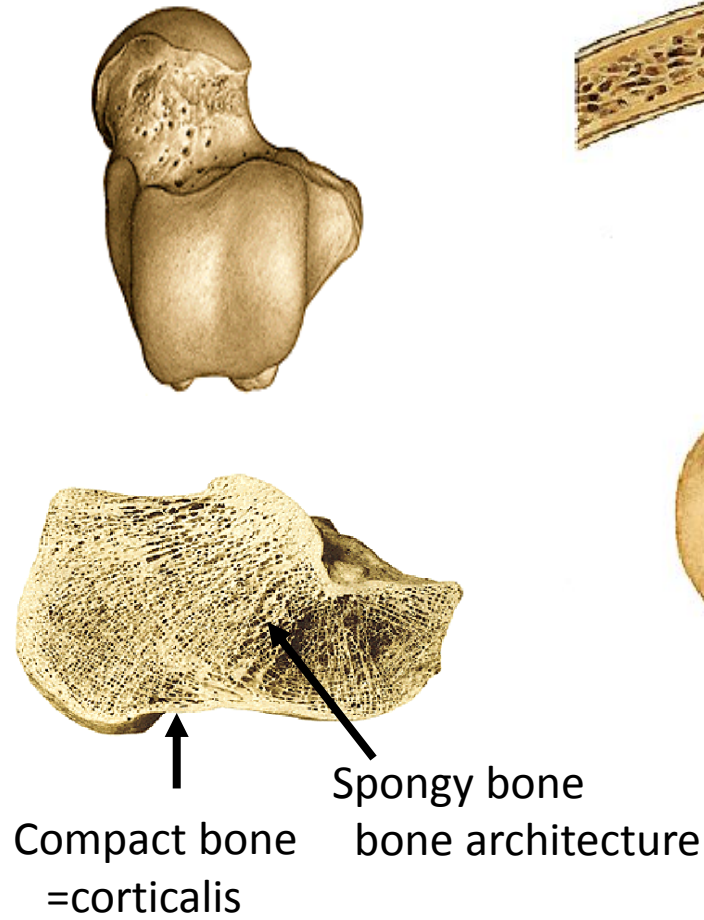
To the **thickness** growth the bone thanks to the **periosteal** cells of the cambial (inner) layer!

# Classification of bones according to the shape

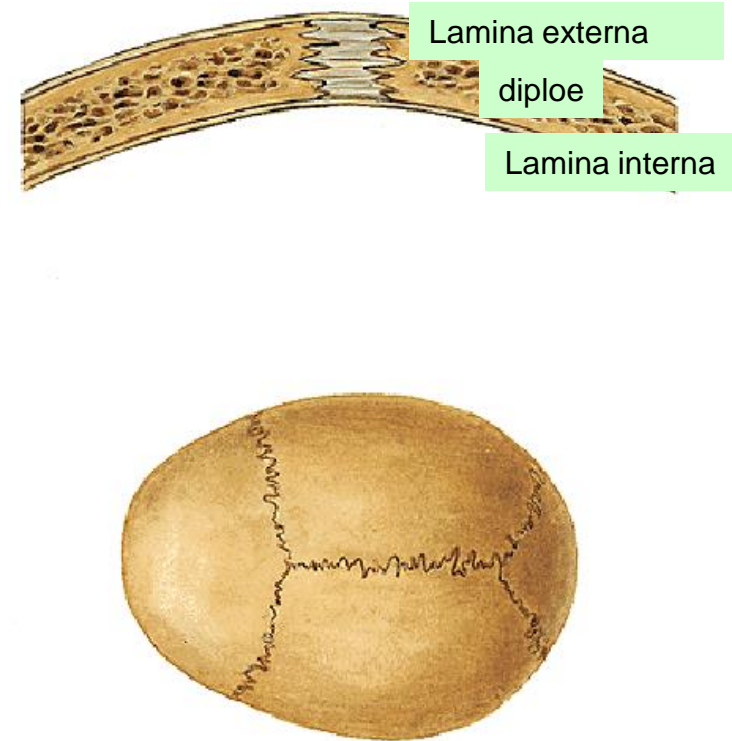
**Ossa longa** (long bones)



**Ossa brevia** (short bones)



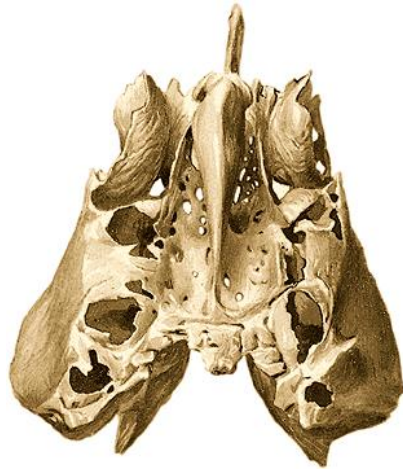
**Ossa plana** (flat bones)



**Ossa sesamoidea** (sesamoid bones) – in tendons of some muscles



**Ossa pneumatica** (pneumatized)  
– paranasal sinuses



**Ossa irregularia** (irregular)





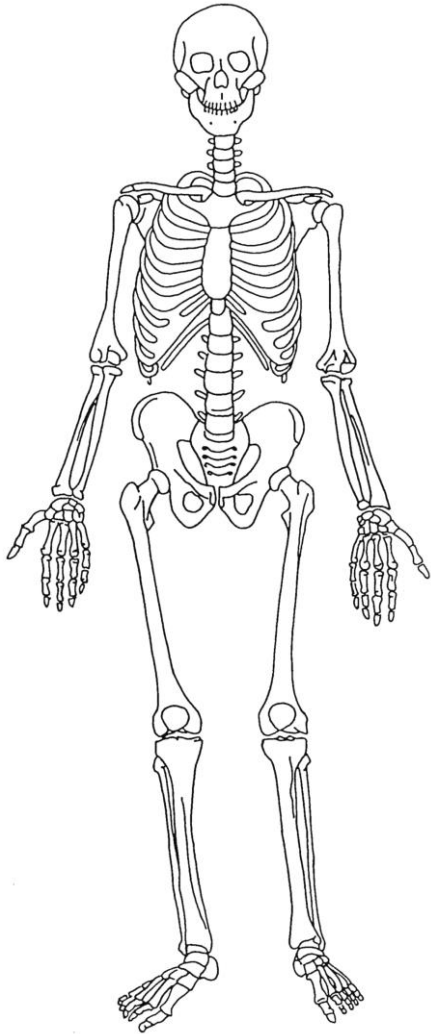
# How to describe bones

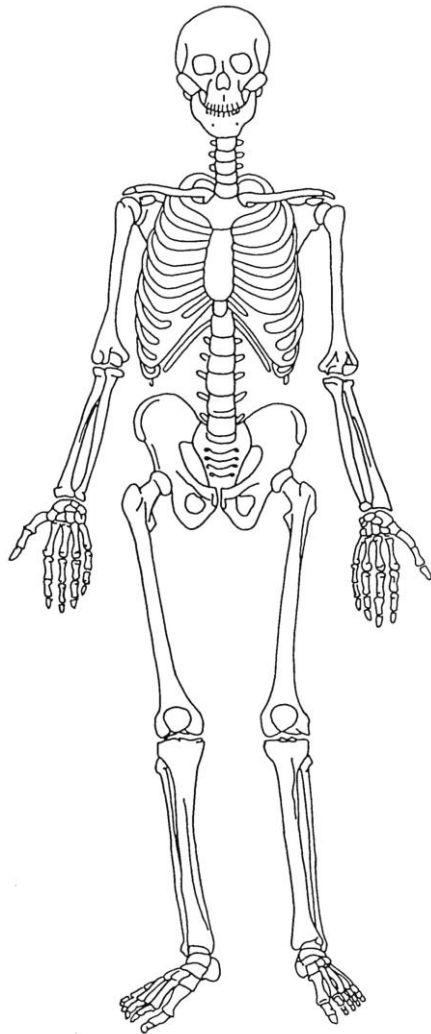
- knowledges of the general osteology, basic orientation on the body with planes are obvious

In describing bones we proceed according to the following outline::

1. Name of the bone (english, latin)
2. Type of the bone (long, short ....)
3. Dividing into separate parts (ends, body, surfaces, borders....)
4. Description of the positive and negative relief of the isolated parts
5. In paired bones estimate the laterality

**IMPORTANT!!! STUDY WITH THE BORROWED MATERIAL IN THE BONY ROOM OR IN THE MUSEUM AT THE DEPARTMENT!!!**





## AXIAL SKELETON

Bones of the skull

Vertebral column (spine)

Ribs

Sternum

} Central line of the body (80)

## APPENDICULAR SKELETON

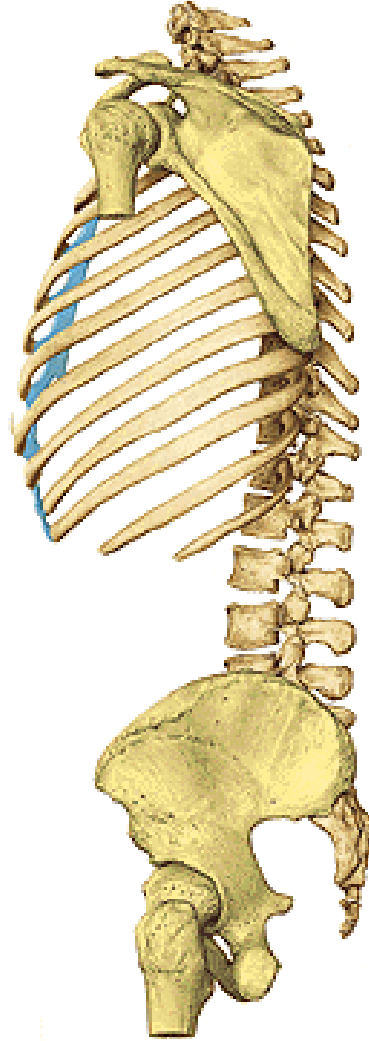
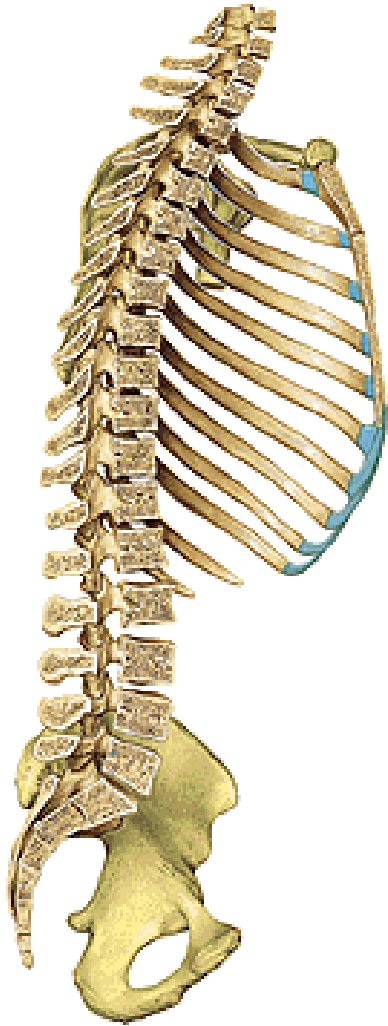
Bones of the limbs

Pectoral girdle

Pelvic girdle

} Attach the limbs to the body's axis (134)

# Thorax



**Columna vertebralis** (vertebral column, spine 26)

**Costae** (ribs, 24)

**Sternum** (breast bone)

# COLUMNA VERTEBRALIS (vertebral column)



33-34, usually 24 free vertebrae

7 vertebrae **cervicales (C)** cervical vertebra

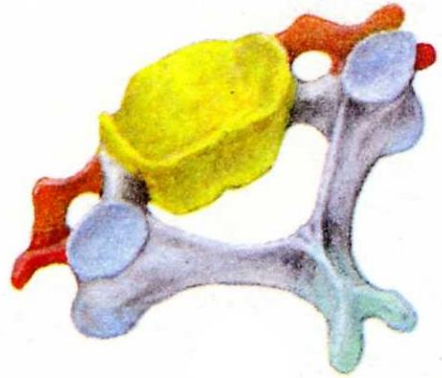
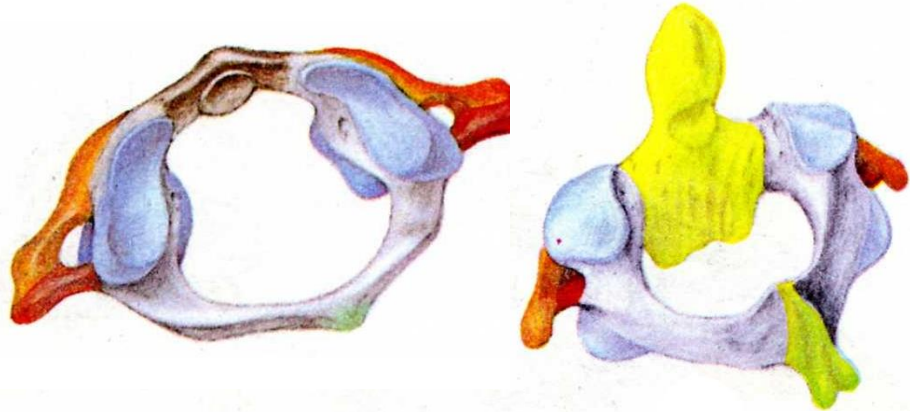
12 vertebrae **thoracicae (Th)** thoracic vertebra

5 vertebrae **lumbales (L)** lumbar vertebra

5 vertebrae **sacrales** – **os sacrum (sacral bone)**

4–5 vertebrae **coccygeae** – **os coccygis (coccyx)**

# DEVELOPMENT OF VERTEBRAS



Corpus vertebrae

Arcus vertebrae

Processus articulares

Processus transversus

Processus spinosus

Costa



# General features of all vertebrae

Corpus vertebrae  
(facies terminalis superior et inferior)

Pediculus arcus vertebrae

Arcus vertebrae

Foramen vertebrale  
(canalis vertebralis)

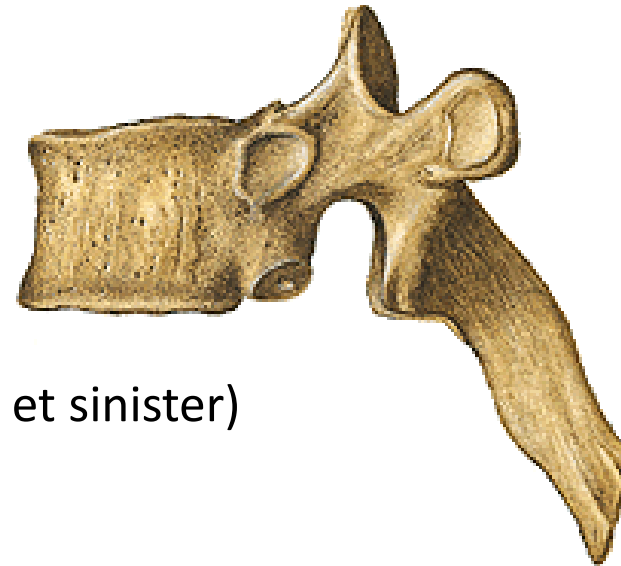
Incisura vertebralis superior et inferior

Foramen intervertebrale

Processus vertebrales  
4x processus articulares  
(processus articularis superior et inferior - dexter et sinister)

2x processus transversus (dexter et sinister)

1x processus spinosus



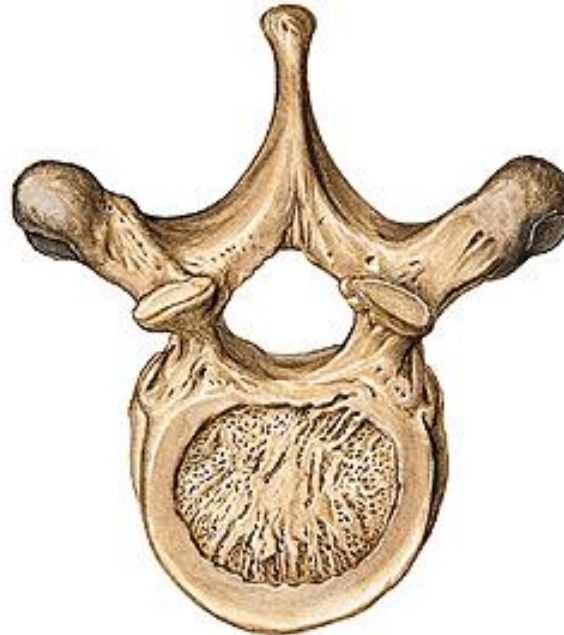
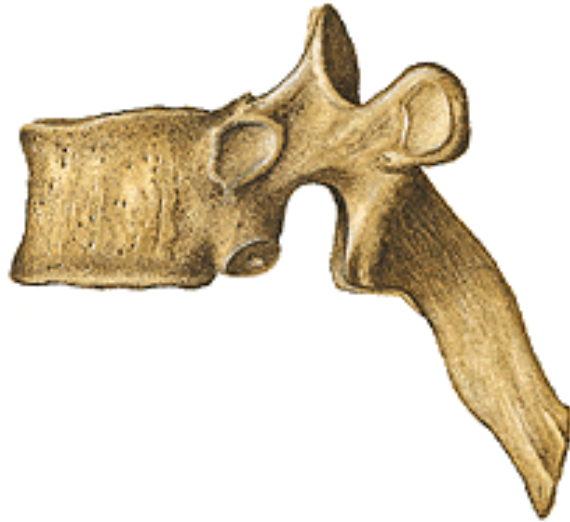
# Processus vertebrales

Processus **articulares** (4)

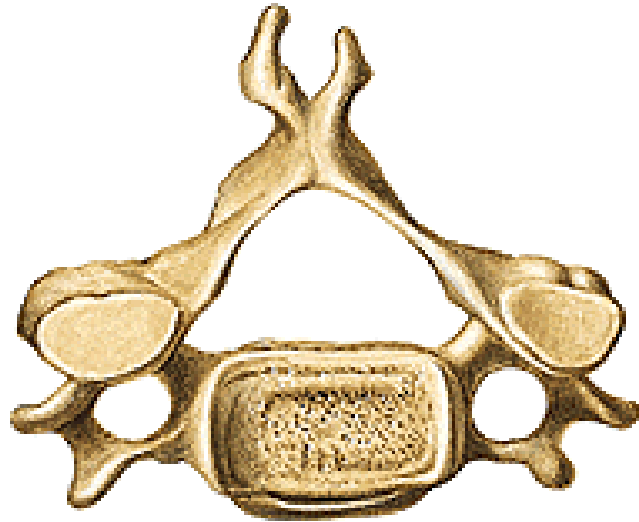
processus articularis superior - dexter et sinister  
processus articularis inferior - dexter et sinister

Processus **transversus** dexter et sinister (2)

Processus **spinosus** (1)



# Vertebrae cervicales C<sub>1</sub> – C<sub>7</sub> (Cervical vertebrae)



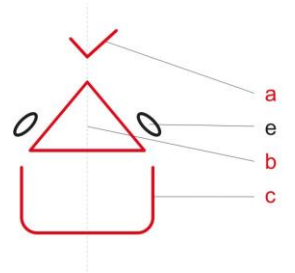
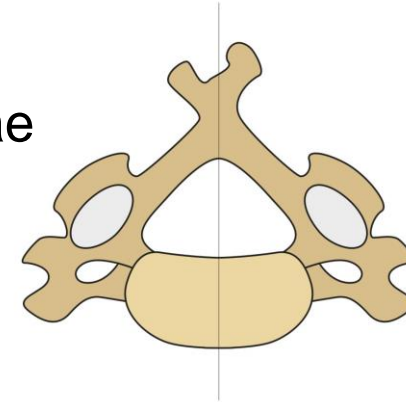
Foramen processus transversari !!!!!

Sulcus nervi spinalis

Tuberculum anterius et posterius processus transversari

Uncus corporis vertebrae

Processus articulares



Bifurcations of the spinous processes (C2 – C6)

C6 - **tuberculum caroticum**

C3 – the smallest body

C7 – **vertebra prominens**



## C<sub>1</sub> - Atlas



### Arcus anterior et posterior atlantis

fovea dentis

tuberculum anterius et posterius atlantis

foramen vertebrale

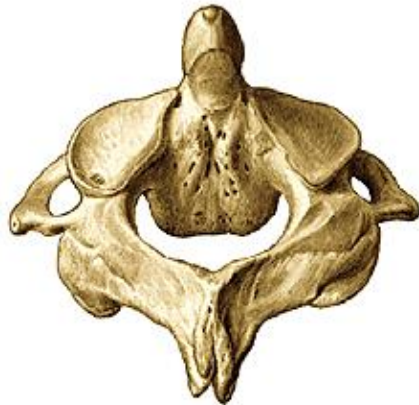
### Massae laterales

facies/fovea articularis superior et inferior

sulcus arteriae vertebralis

processus transversi

## C<sub>2</sub> - Axis



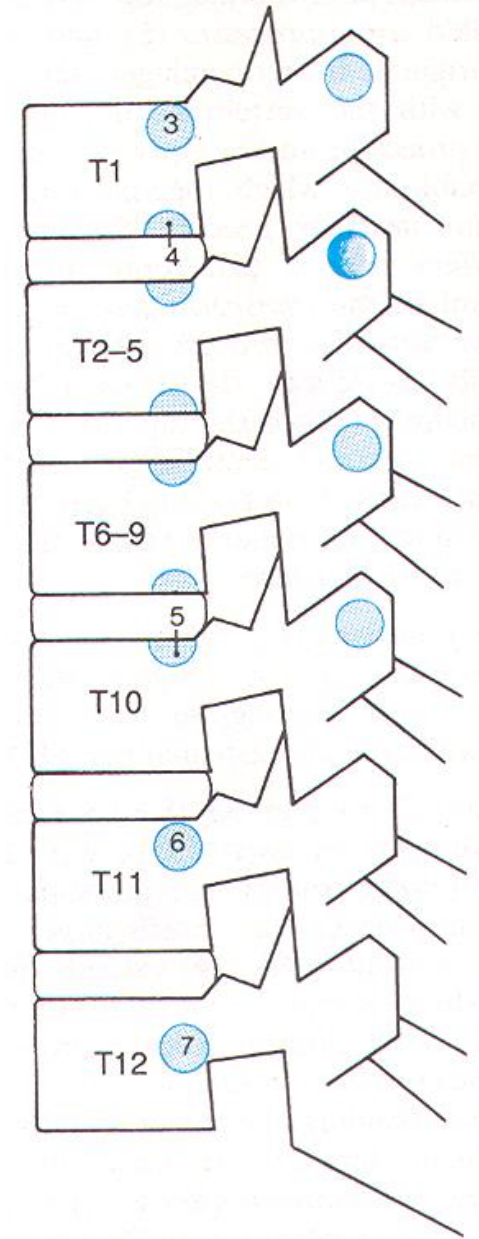
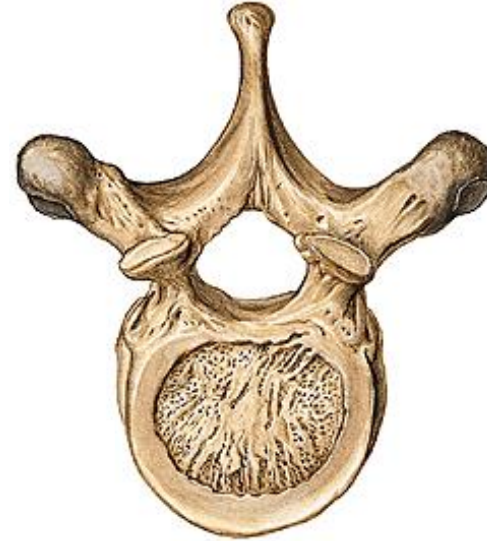
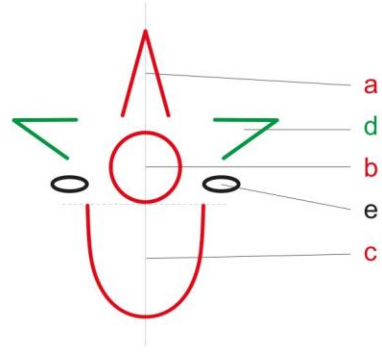
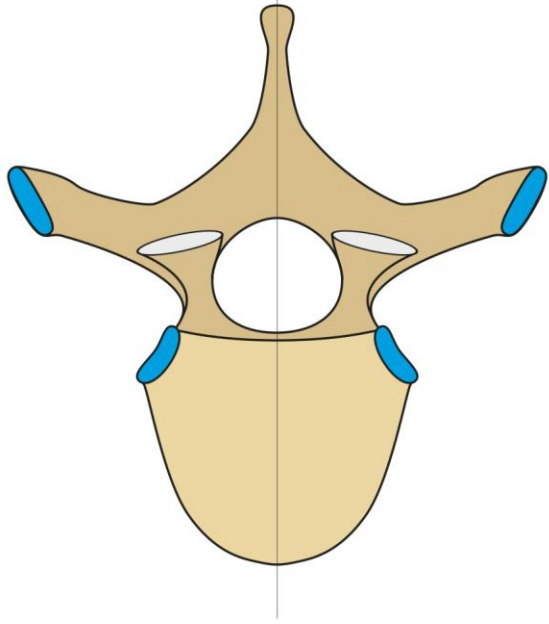
### Corpus vertebrae

### Dens axis

facies articularis ant. et post. dentis

apex dentis

# Vertebrae thoracicae Th<sub>1</sub> – Th<sub>12</sub> (thoracic vertebrae)



fovea costalis (dextra et sinistra)

fovea costalis processus transversus

processus articulares

# Vertebrae lumbales L<sub>1</sub> – L<sub>5</sub> (lumbar vertebrae)



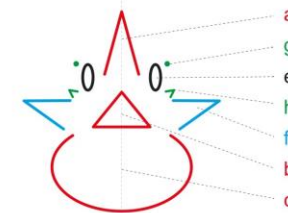
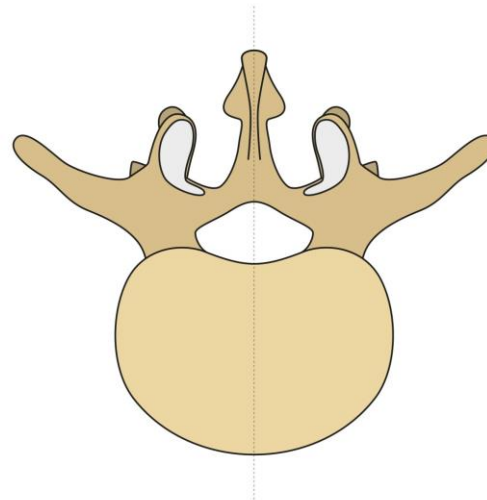
processus costarii

processus mammillares

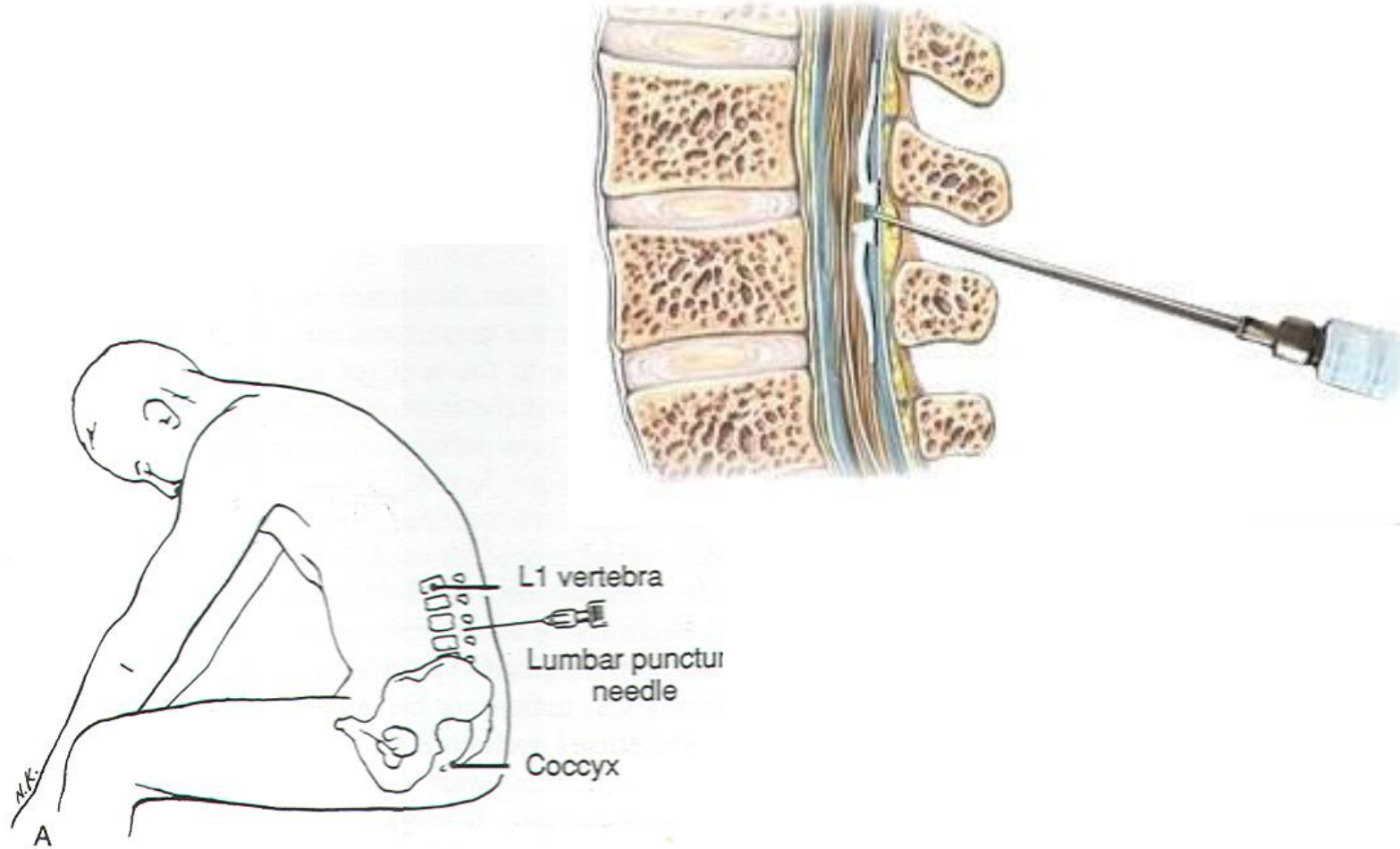
processus accessorii

Processus articulares

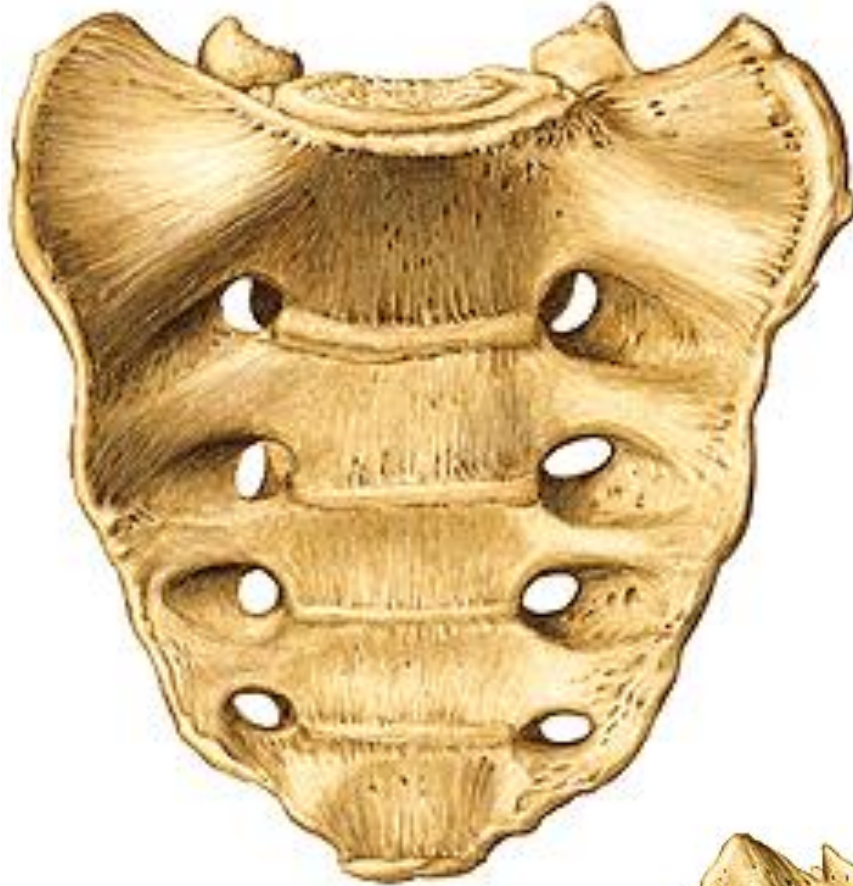
Shape and direction of spinous process



# Lumbar puncture - between L<sub>3</sub> – L<sub>4</sub> Cerebral liquor



# Vertebrae sacrales, os sacrum (sacral bone)



**basis** – facies terminalis superior

**apex** – facies terminalis inferior

**facies pelvina**

lineae transversales

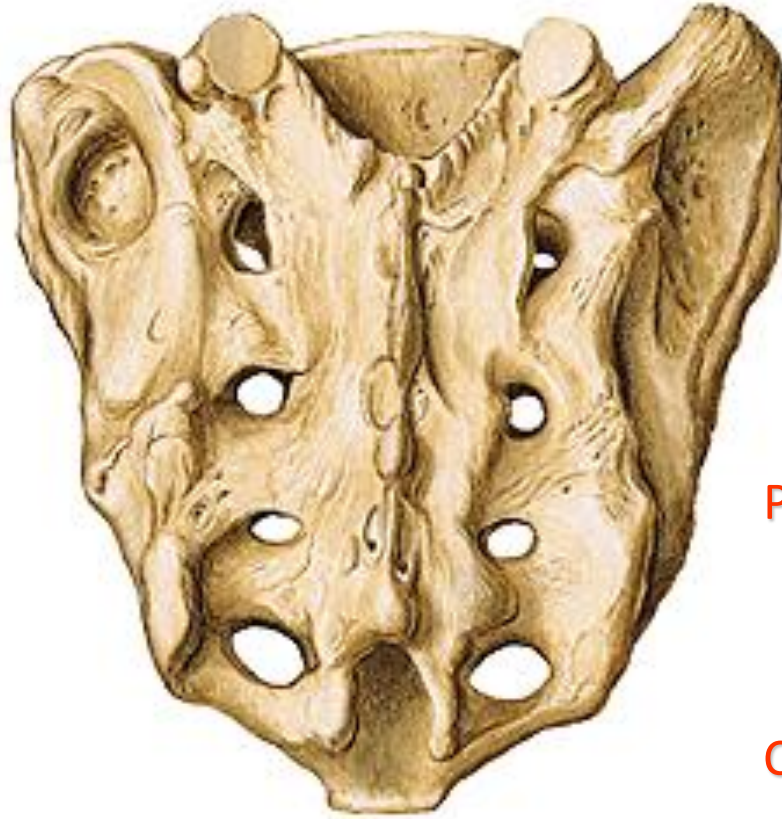
foramina sacralia pelvina

promontorium

**canalis sacralis** – hiatus canalis sacralis  
cornua sacralia



# Os sacrum



## Facies dorsalis

crista sacralis mediana

cristae sacrales intermediae

cristae sacrales laterales

foramina sacralia dorsalia

tuberositas sacralis

## Partes laterales

facies auriculares

## Canalis sacralis

hiatus canalis sacralis

cornua sacralia



# Vertebrae coccygeae, os coccygis (coccyx) (Co<sub>1</sub> – Co<sub>4-5</sub>)

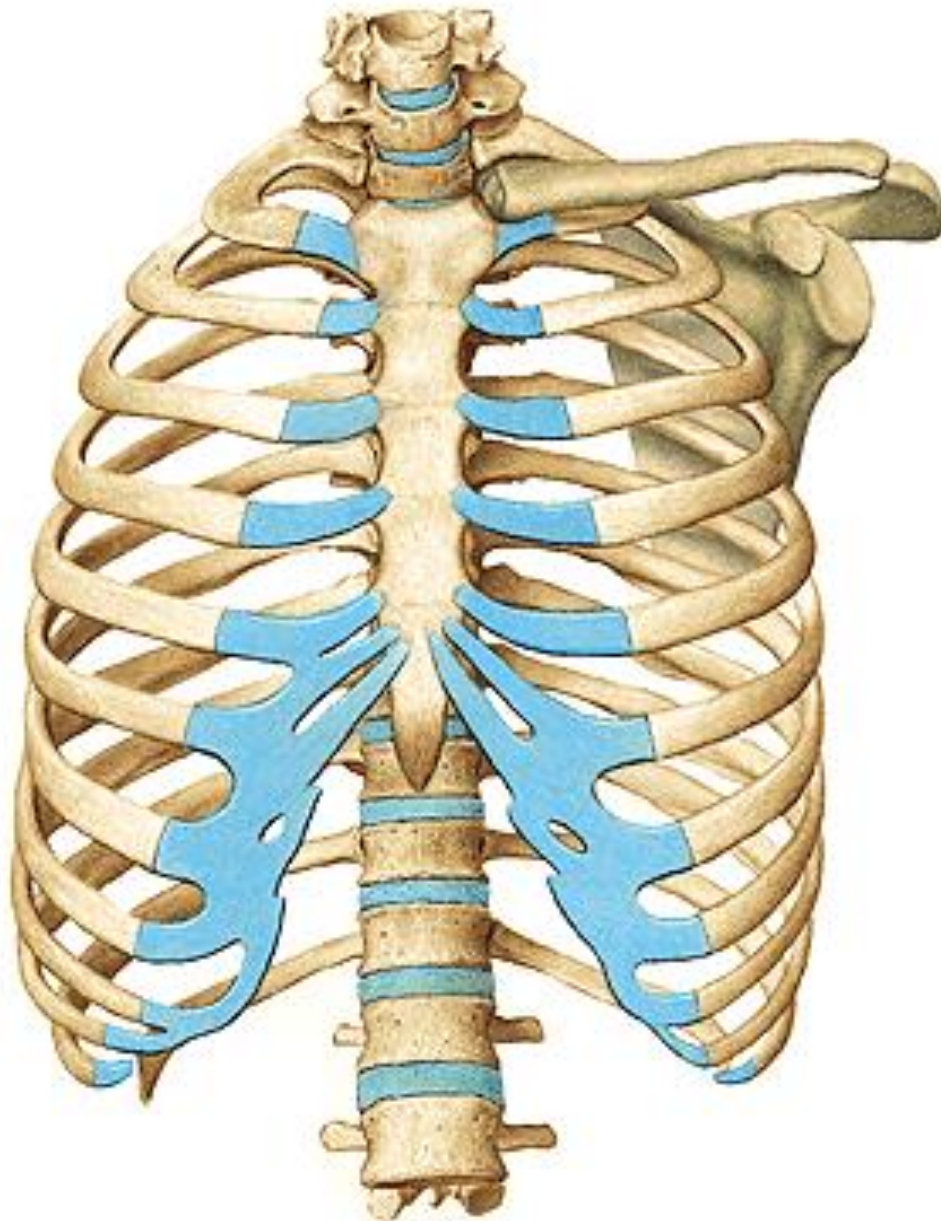


basis – facies terminalis superior

cornua ossis coccygis

apex

## Costa, rib (12)



Costae verae (1.-7.)

Costae spuriae (8.-10.)

Costae fluctuantes (11., 12.)

Cervical rib

Lumbar rib (near to the kidneys)





Os costae

Cartilago costae

Caput

facies articularis

(2. - 10. rib - crista capitis costae)

Collum

tuberculum costae

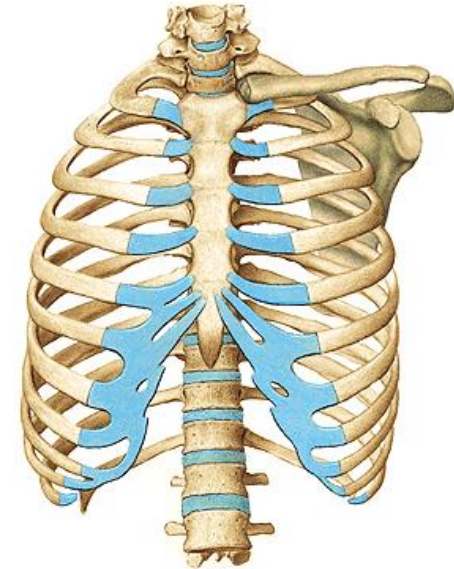
facies articularis tuberculi costae

Corpus

angulus costae

crista costae

sulcus costae





## Costa prima

tuberculum musculi scaleni anterioris

sulcus arteriae subclaviae

tuberculum musculi scaleni medii

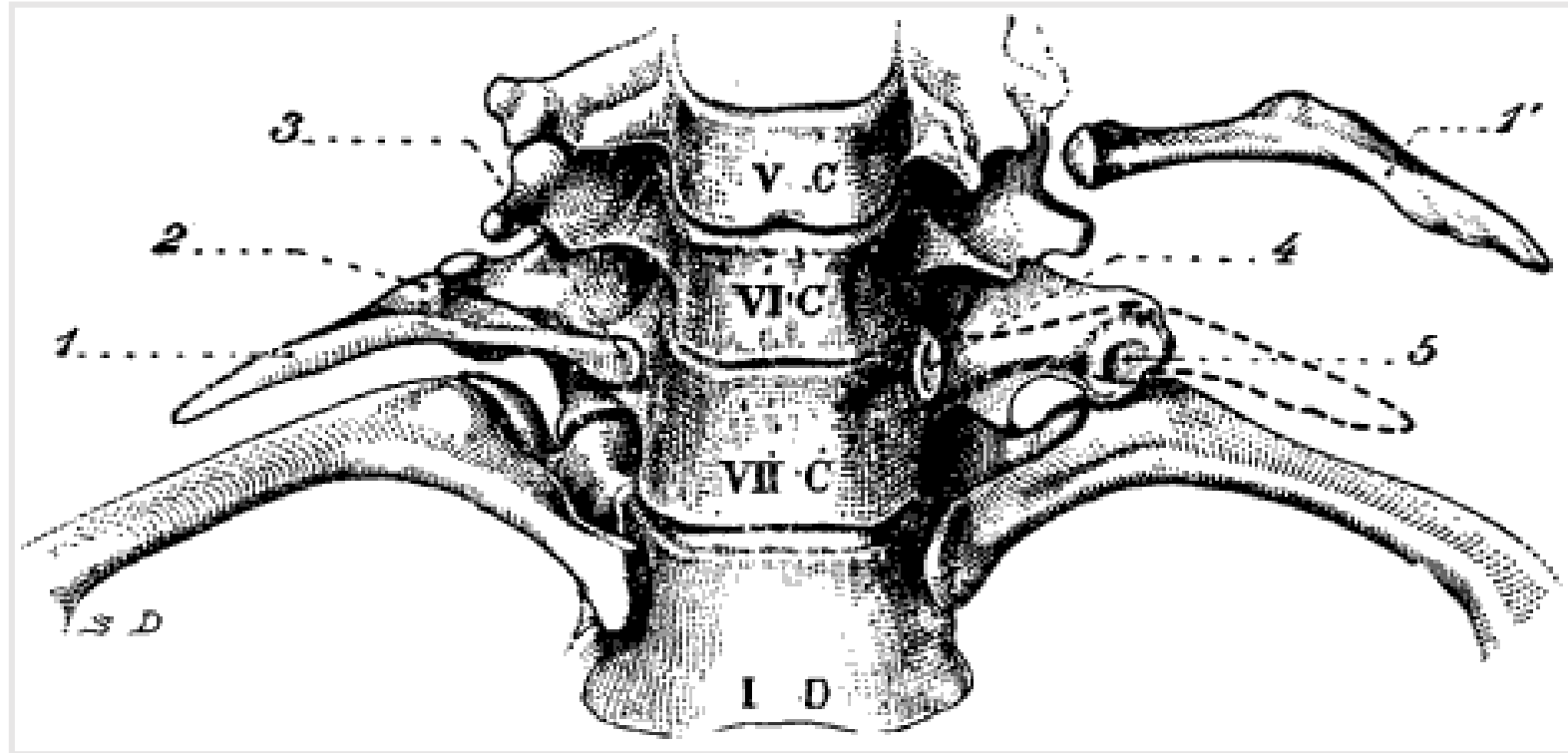
## Costa secunda

tuberositas musculi scaleni posterioris

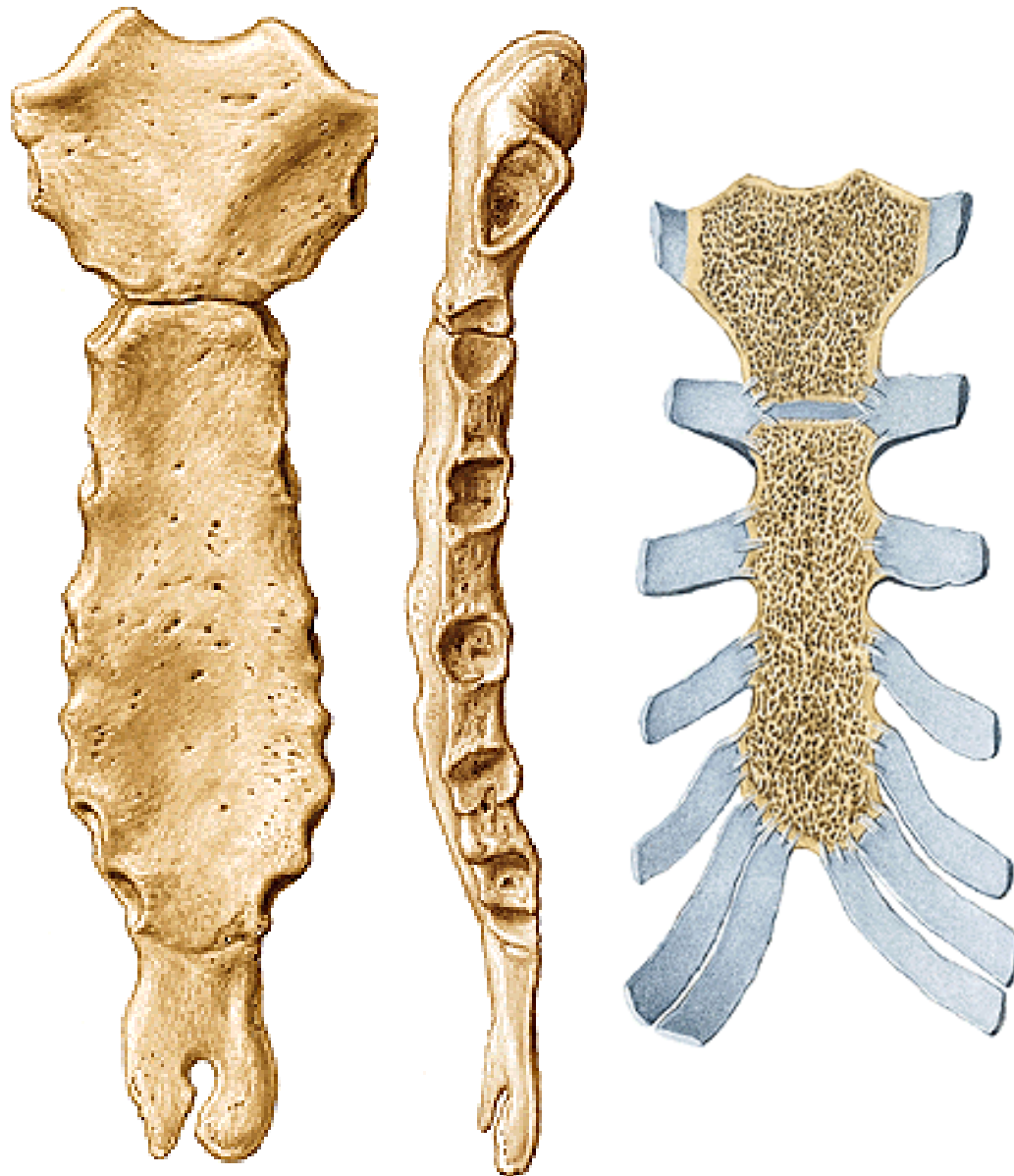
tuberositas musculi serrati anterioris

11. and 12. ribs – tuberculum costae and sulcus costae are missing!!!

## Cervical rib



# Sternum (breast bone)



## Manubrium sterni

incisura clavicularis

incisura jugularis

incisurae costales 1.,2.

## Angulus sterni

## Corpus sterni

incisurae costales (3.-7. žebro)

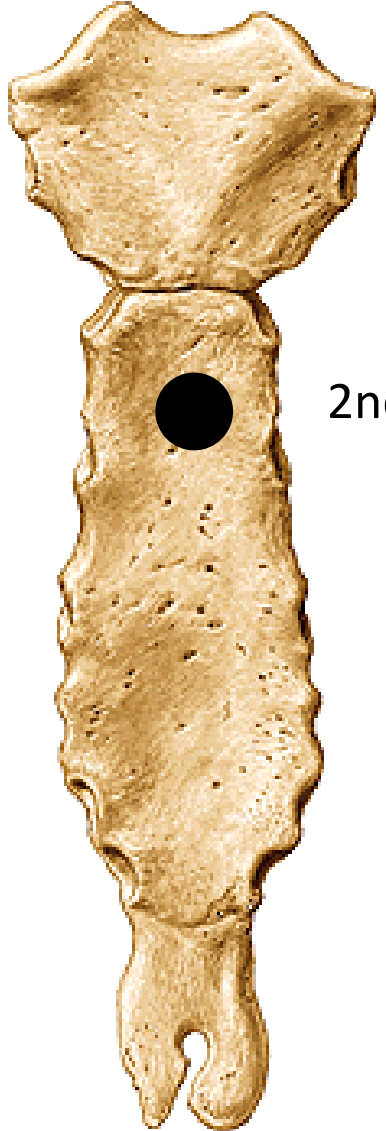
## Processus xiphoideus



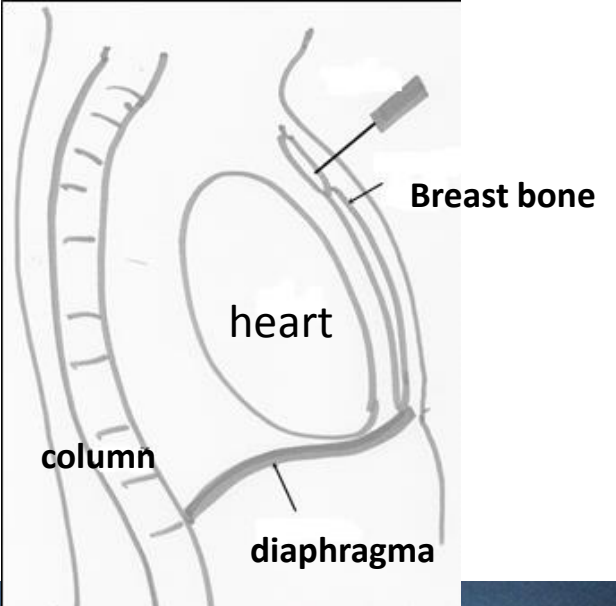
Sternebrae

Hollow in the body of the breast bone

# Sternal puncture



2nd intercostal space



# Any questions?

## The pictures used in this lectures were taken from following sources:

- **Atlas der Anatomie des Menschen/Sobotta. Putz,R., und Pabst,R. 20. Auflage. München:Urban & Schwarzenberg, 1993**
- **Netter: Interactive Atlas of Human Anatomy.**
- **Naňka, Elišková: Přehled anatomie. Galén, Praha 2009.**
- **Čihák: Anatomie I, II, III.**
- **Drake et al: Gray's Anatomy for Students. 2010**
- **Own archiv of the lecturer**