

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

1. lecture and seminar, DENTISTRY AUTUMN 2016

Lecturer: RNDr. MICHAELA RAČANSKÁ, Ph.D.

Department of Anatomy

- Blue floor: dissecting rooms
- Red floor: seminar rooms,
computer room,
ossarium (**lending bones** against to the index, it is not allowed to take them away from the department, you can study in the red floor),
room with X-rays,
museum, space for students
- Yellow floor: offices, laboratories

Lending of bones (first five weeks of tuition)

monday

8– 16. 00*

tuesday

8 – 16.00*

wednesday

8.00 – 17.00*

thursday

8.00 – 17.00*

friday

8.00 – 16.00*

***in each whole hour, lending bones** against to ISIC, it is not allowed to take them away from the department, you can study in the red floor

Syllabus

Lectures: We 13,20-15,00

Seminars: We 15,40- 17,20

Change! App.13,30-16,50 lecture and seminar together

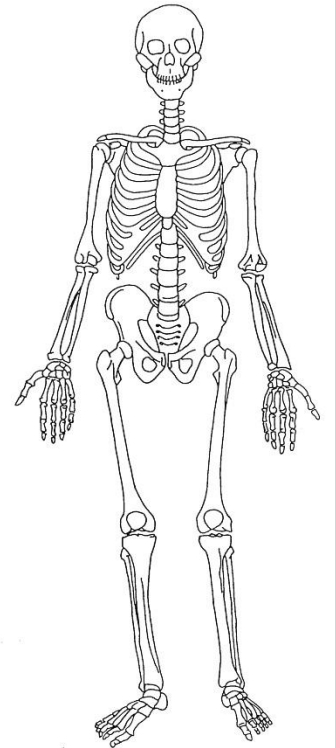
P2 blue floor

Week and date		Lectures	Seminars
1.	21. 9. 2016	Planes and direction of the body. General osteology. Skeleton of the spine and thorax.	Introduction to the study, X-rays anatomy. Anatomical museum.
2.	28. 9. 2016	State holiday	
3.	5. 10. 2016	Skeleton of the upper limb.	Skeleton of the upper limb
4.	12. 10. 2016	Skeleton of the lower limb	Skeleton of the upper extremity and lower extremity
5.	19. 10. 2016	Neurocranium	Neurocranium
6.	26. 10. 2016	Splanchnocranium	Splanchnocranium
7.	2. 11. 2016	Cavities of the skull	Cavities of the skull
8.	9. 11. 2016	General arthrology Joints of the skull, spine and thorax	General arthrology Joints of the skull, spine and thorax.
9.	16. 11. 2016	Joints of the upper extremity and lower extremity, pelvis	Joints of the upper extremity and lower extremity. The pelvis.
10.	23. 11. 2016	- ,,,,,,,self study	- ,,,,,,,self study
11.	30. 11. 2016	Control examination (osteology, arthrology)	
12.	7. 12. 2016	General myology. Introduction to the study of the muscles Muscles and fasciae of the head and neck The muscles of the thorax, abdomen and back	Muscles and fasciae of the head. The muscles of the thorax, abdomen and back
13.	14. 12. 2016	Muscles of the upper extremity	Muscles of the upper extremity
14.	21. 12. 2016	Muscles of the lower extremity	Muscles of the lower extremity
15.	4. 1. 2016	Spare lectures	

Course objectives

At the end of the course students should be able to:

1. Name all parts of the human skeleton including the detailed relief.
2. Describe correctly joints of the bones.
3. Describe the movements occurring at each joint.
4. Identify individual muscles of the human body, discuss their attachments and innervations. Define actions of individual muscles and muscular groups.
5. Define skeletal structures demonstrated by radiographs in basic projections.



Where you can study from?

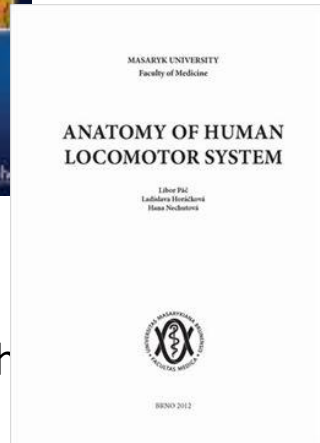
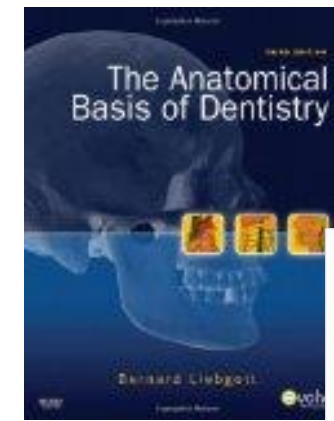
Liebgoth, Bernard. *The anatomical basis of dentistry*. 3rd ed. Mosby, ISBN 0-323-06807-3

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.

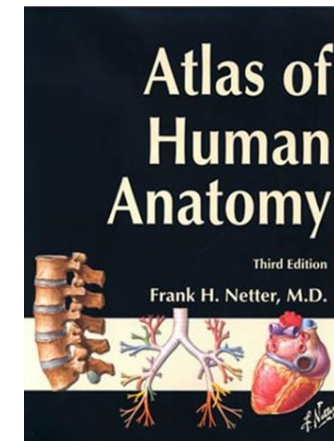
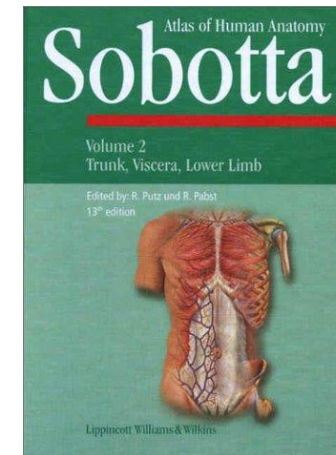
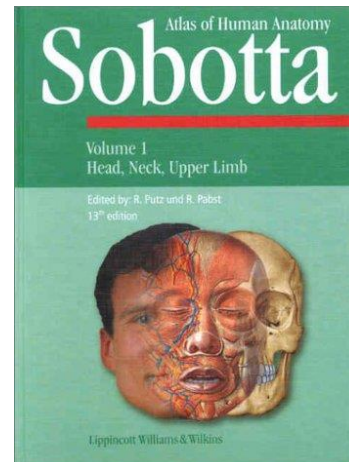
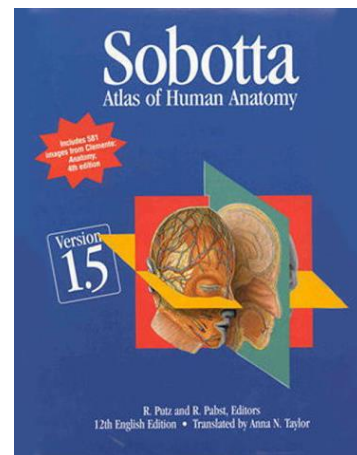
Atlas of human anatomy. Edited by Johannes Sobotta - Reinhard Putz - Reinhard Pabst - Renate Putz. 13th English ed., 21st Germa. Philadelphia: Lippincott Williams & Wilkins, 2001. 404 s. ISBN 0-7817-3174-7.

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

Frame – studying materials on the IS



Test on the beginning of each lecture!!!



**WHAT YOU WILL NEED?
and
SAFETY AT WORK**

Long hair pin together, painted nails, earrings, rings and bracelets x



Cases
Lock and the key



OR



Probe (skewer, pin ...)



Later





Safety at work

- Every accident (even small injuries) that happens during your education immediately report, write to the accident book, and will be treated
- If a student becomes pregnant – please report, not allowed to attend the dissection rooms





Anatomical nomenclature

Terminologia Anatomica – International Anatomical terminology (FCAT) 1998

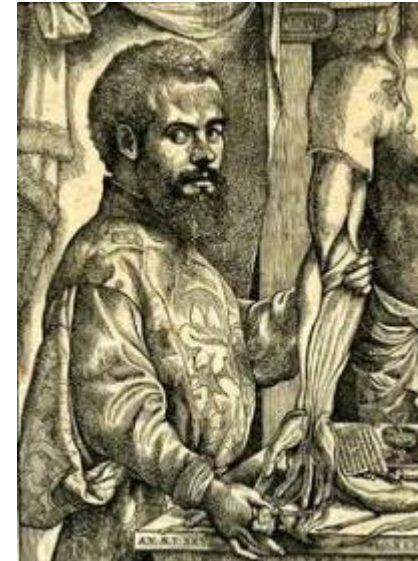
Anatomy is the basis of the language of medicine. Students learn a new language consisting of at least 4500 words. International.

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)
- 5. **TERMINOLOGIA ANATOMICA 1998**



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)

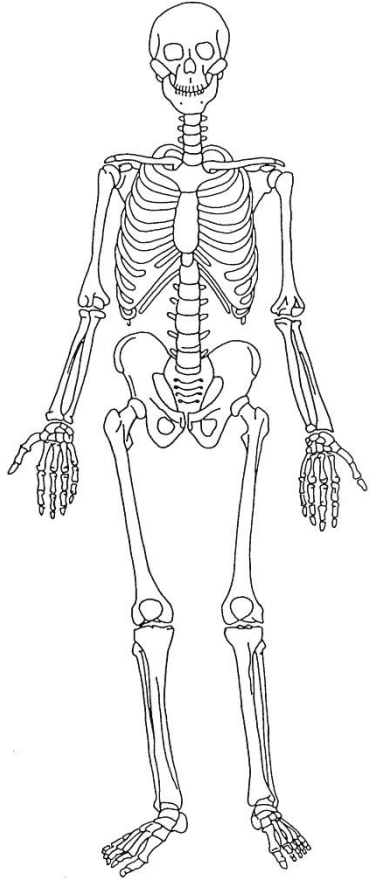
Spina (a thorn) **iliaca** (iliac) **anterior** (fore) **superior** (upper) **ossis coxae** (of coxal bone)

Epicondylus medialis humeri

Epicondylus medialis femoris



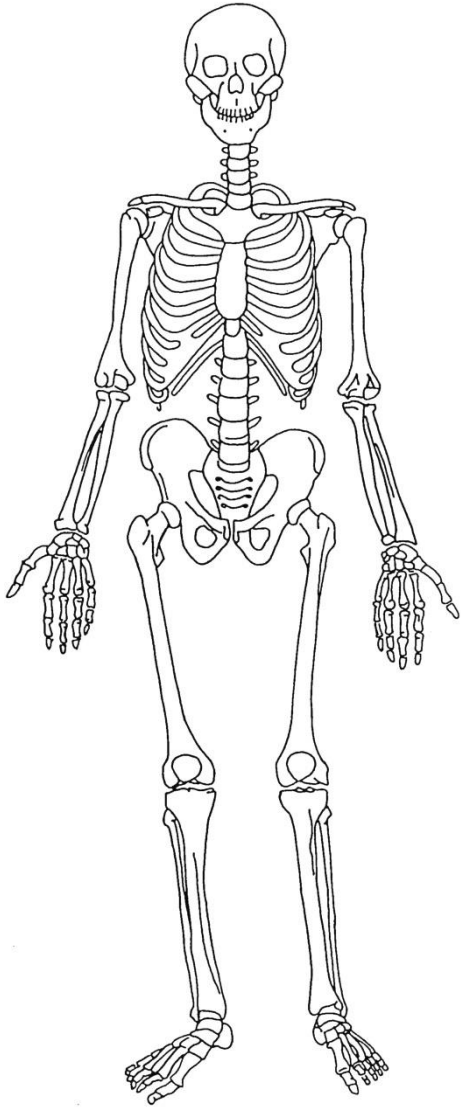
General osteology



Before we'll start, take a piece of paper and write down what you already know regarding:

- What is the composition of the bone?
- What types of bones do you know?

General osteology



- The skeleton is composed of a living, dynamic, rigid, connective tissue that forms bones and cartilages
- In total 214 (incl. sessamoid 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 %



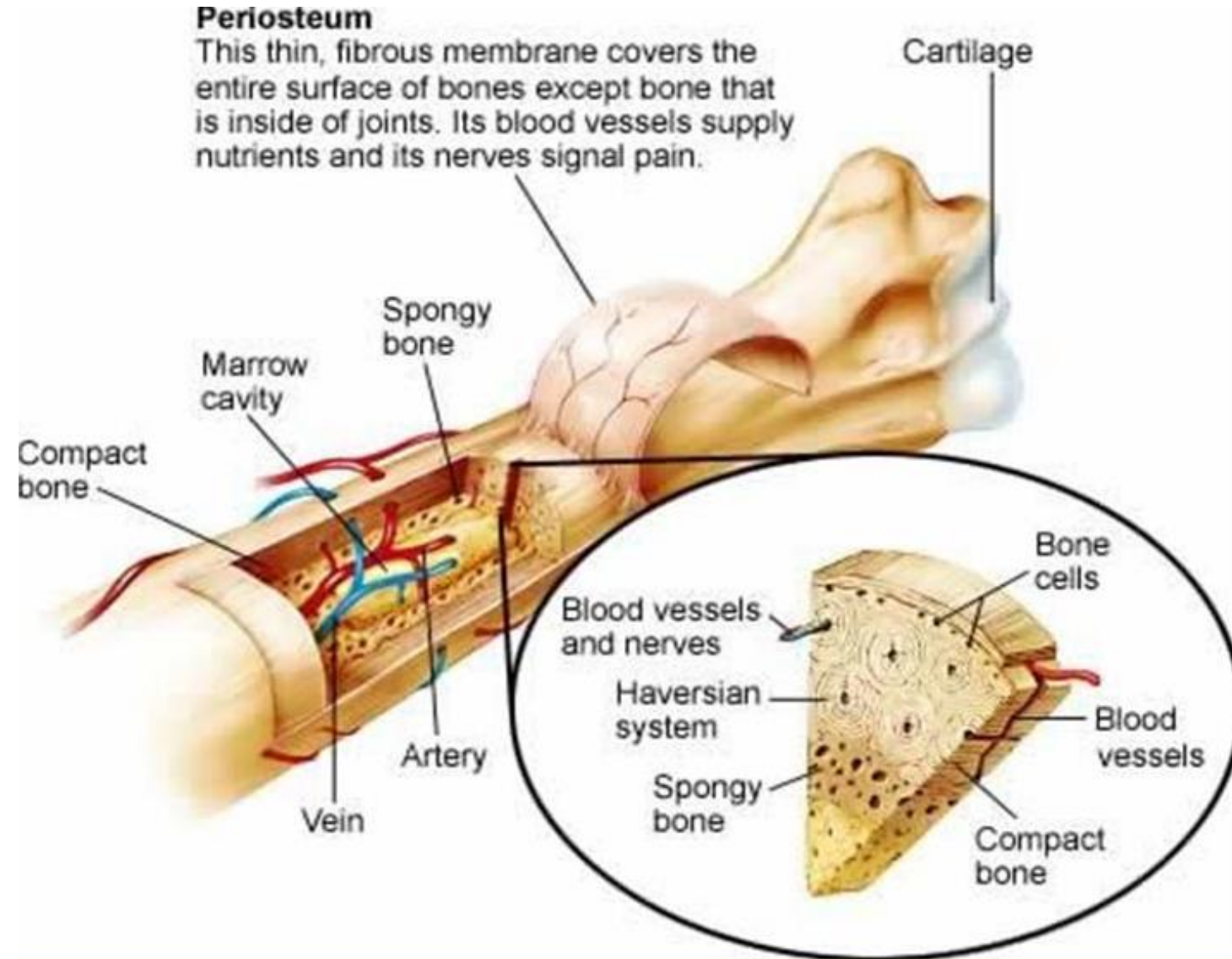
TYPES OF BONE ACCORDING TO THE STRUCTURE

1) compact bone

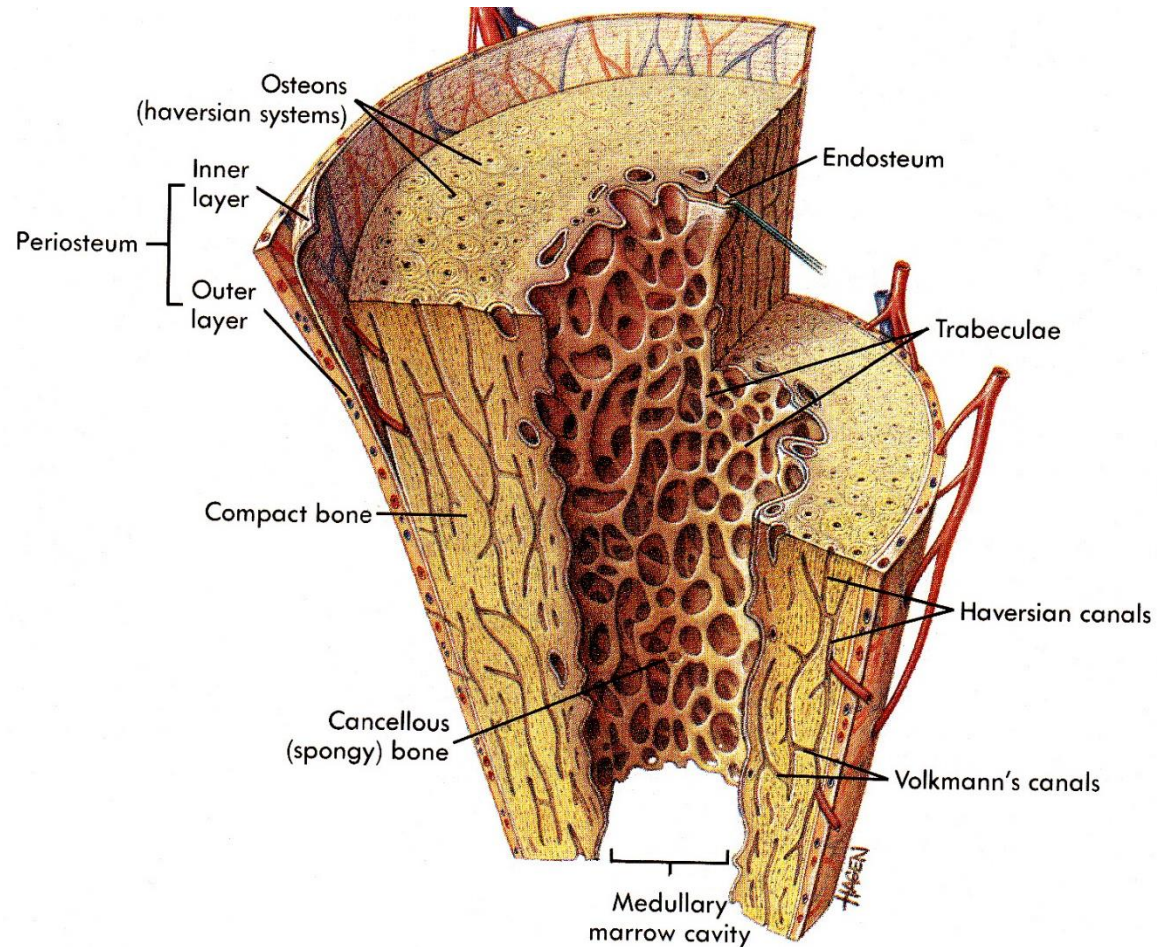
A relatively solid mass of bone
Commonly seen as a superficial layer
of bone, that provides strenght

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 (periost)

Internal cambious layer

(osteoblasts, Sharpey's fibers, remodeling the site of osteoblasts – built up bone and help of healing – fractures)

Substantia compacta



Substantia spongiosa

Bone architecture, trajectories

Endosteum

Bone reconstruction, it is not possible to peel it off

Cavitas medullaris

- (bone marrow)

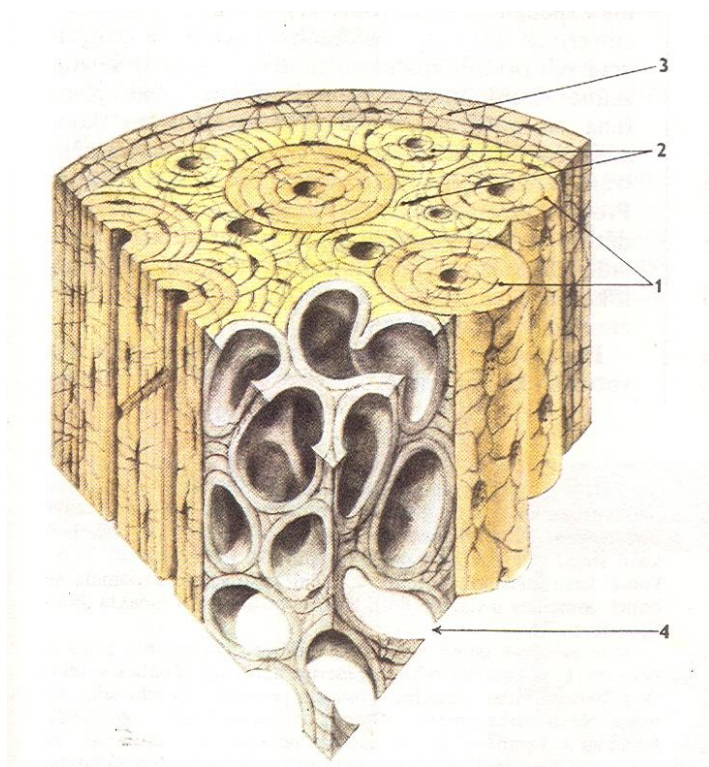
medulla ossium rubra

medulla ossium flava

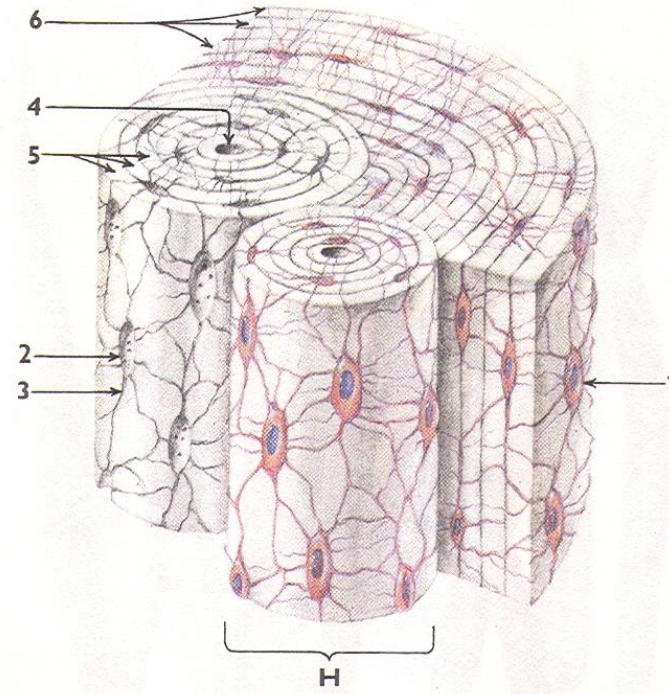
medulla ossium gelatinosa



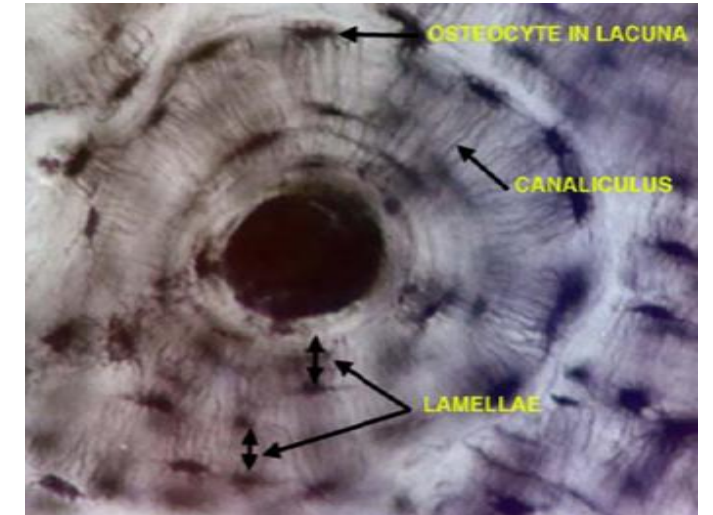
Lamellar bone tissue



- 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



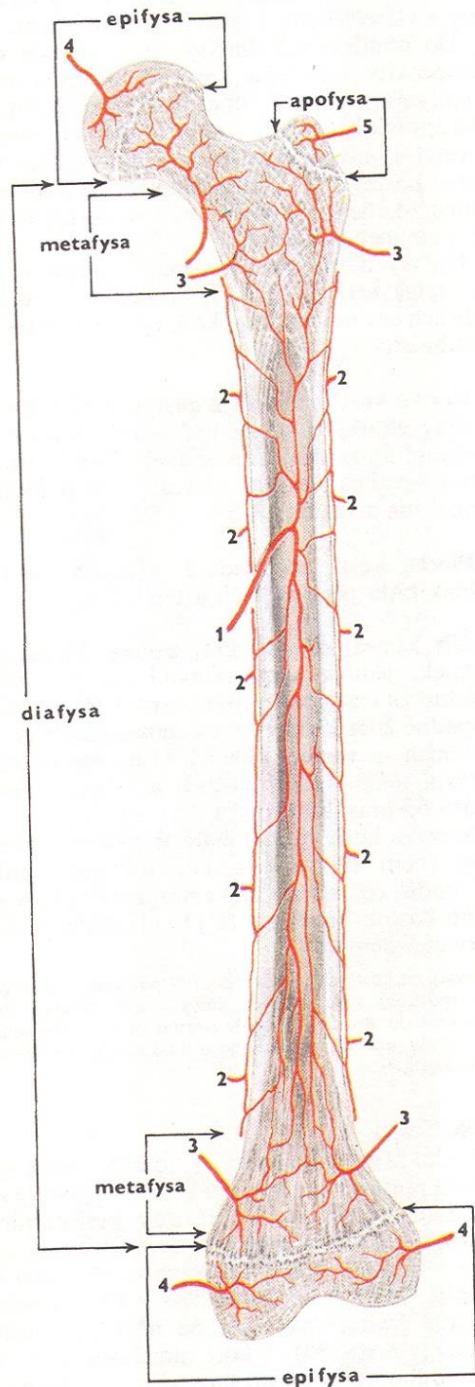
BONE MARROW

Medulla ossium rubra – red bone marrow
(active hematopoietic tissue)

Medulla ossium flava – yellow bone marrow
(source of energy for organism)

Medulla ossium gelatinosa – grey bone marrow





BLOOD SUPPLY

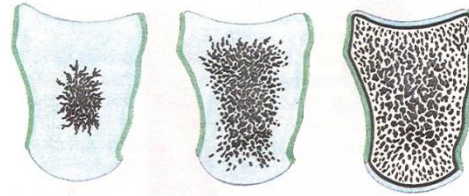
- Nutrient arteries (one or more, through the diaphysis)
- Periosteal arteries (supply the compact bone)
- Metaphysial arteries
- Epiphyseal arteries
- Apophyseal arteries

BONE DEVELOPMENT (ossification)

1) Intramembranous formation

Flat bones

Direct calcium deposition
into mesenchymal model of the bone

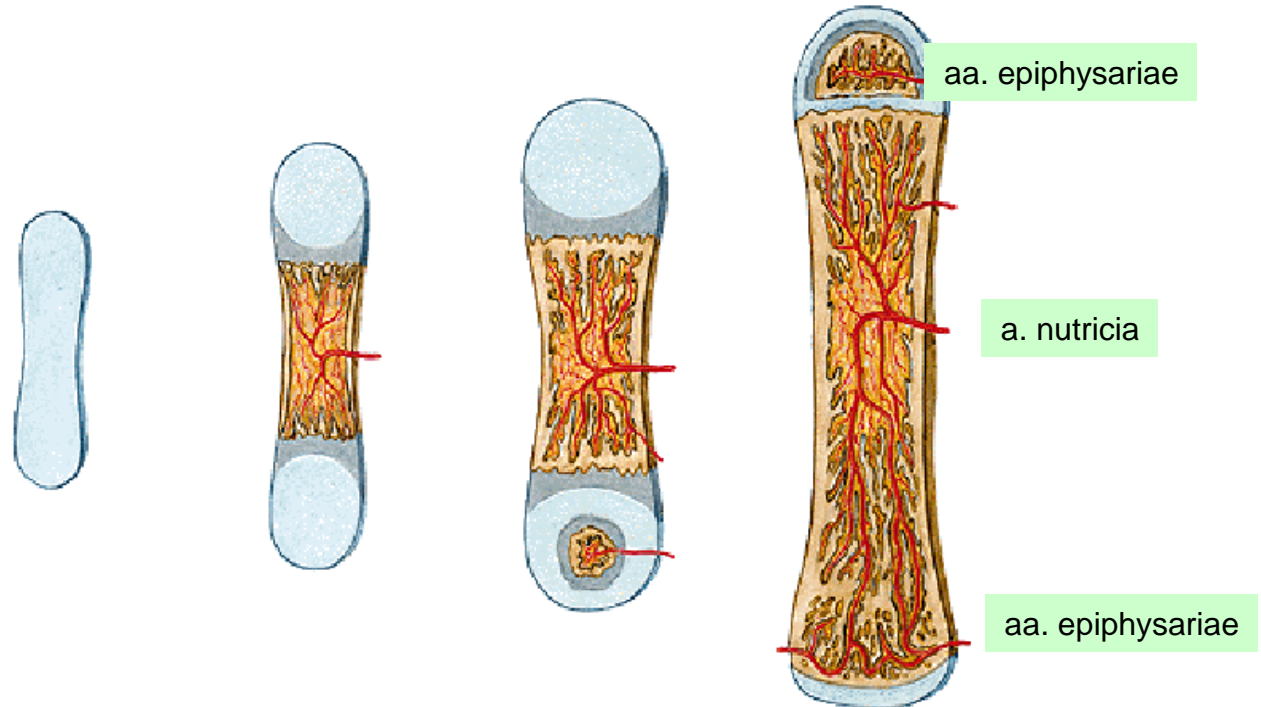


2) Endochondral formation

Long bones, irregular bones

Calcium deposition into a cartilaginous
model of the bone

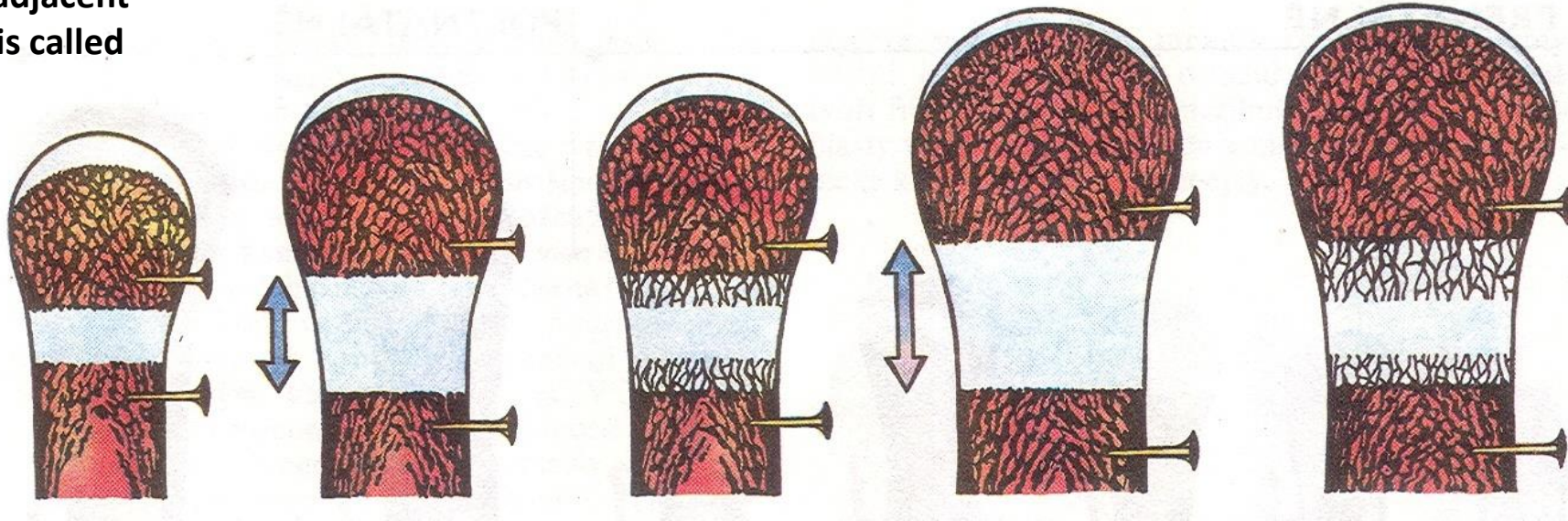
- a) perichondral
originates in diaphysis
- b) enchondral
in cartilage near epiphyses



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.

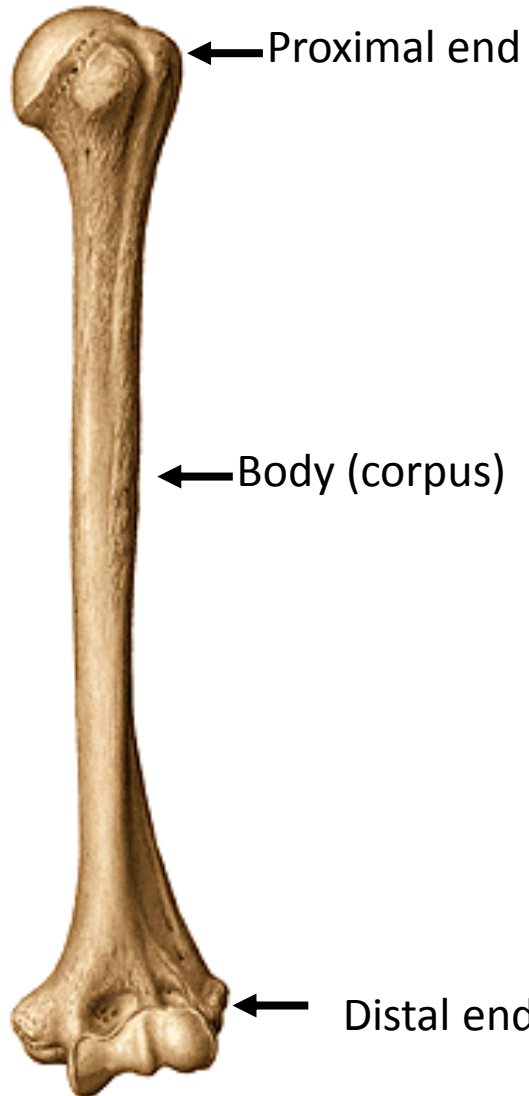


Growing of the **epiphyseal cartilage** followed by the ossification of both epiphysis and diaphysis
as the background of growing into the **length**

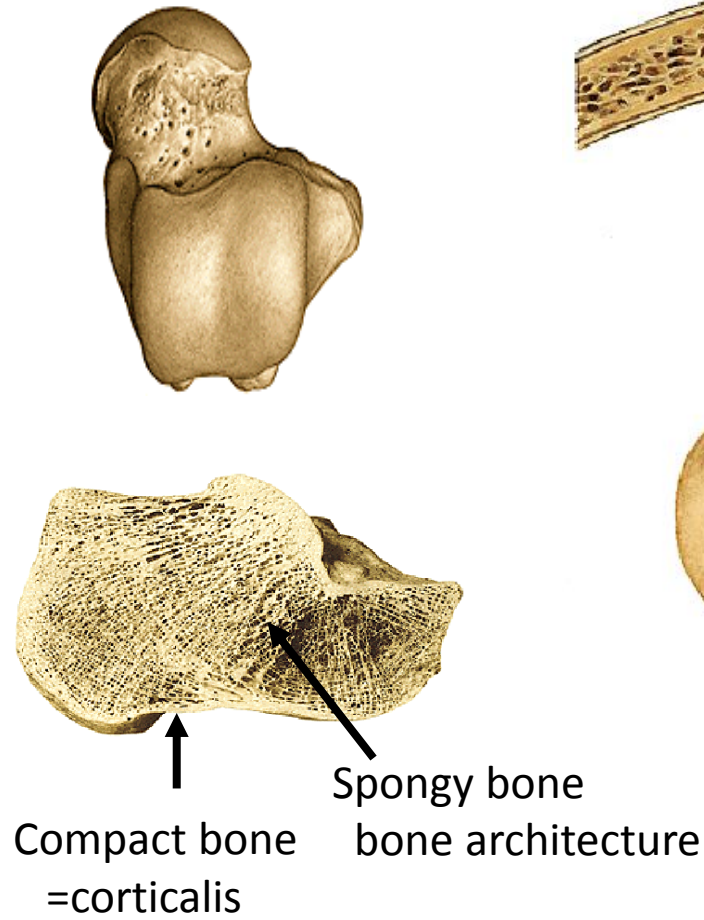
To the **thickness** growth the bone thanks to the **periosteal** cells of the cambial (inner) layer!

Classification of bones according to the shape

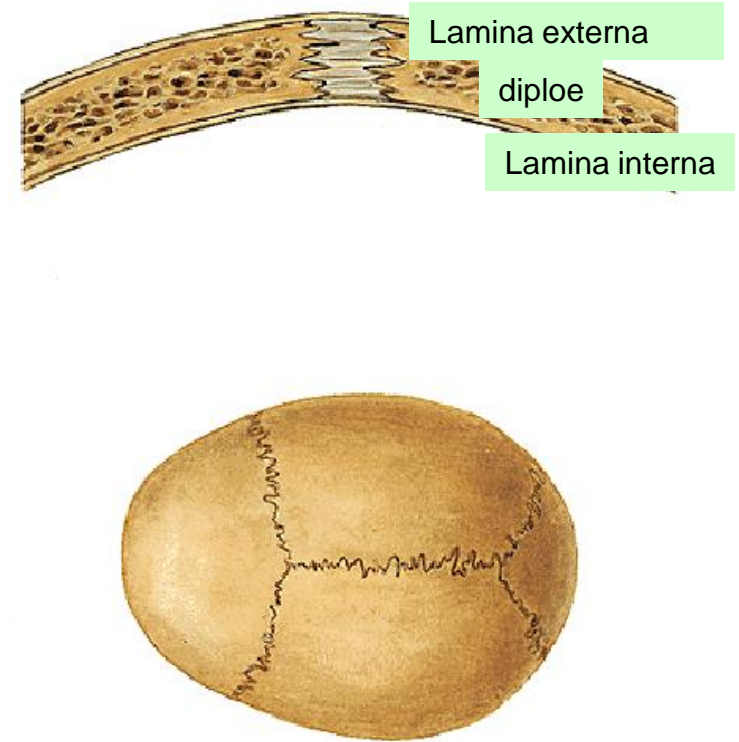
Ossa longa (long bones)



Ossa brevia (short bones)



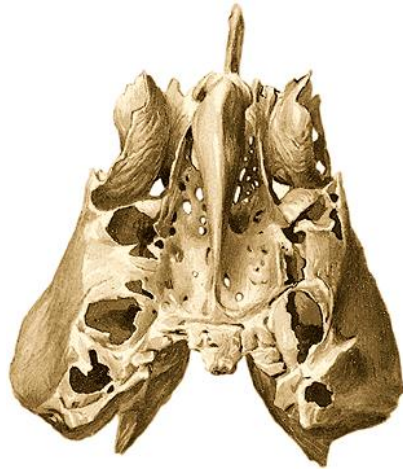
Ossa plana (flat bones)



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



Ossa pneumatica (pneumatized)
– paranasal sinuses



Ossa irregularia (irregular)





Control questions?

The bones are classified by their shape.

Which of the following shapes is used to define the kneecap (patella)?

- a. Long
- b. Flat
- c. Irregular
- d. Short
- e. Sesamoidal

Which of the following portions of the long bone is most important in lengthening the bone?

- a. Diaphysis
- b. Epiphysis
- c. Epiphyseal plate
- d. Apophysis
- e. metaphysis

Orientation on the body



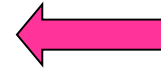
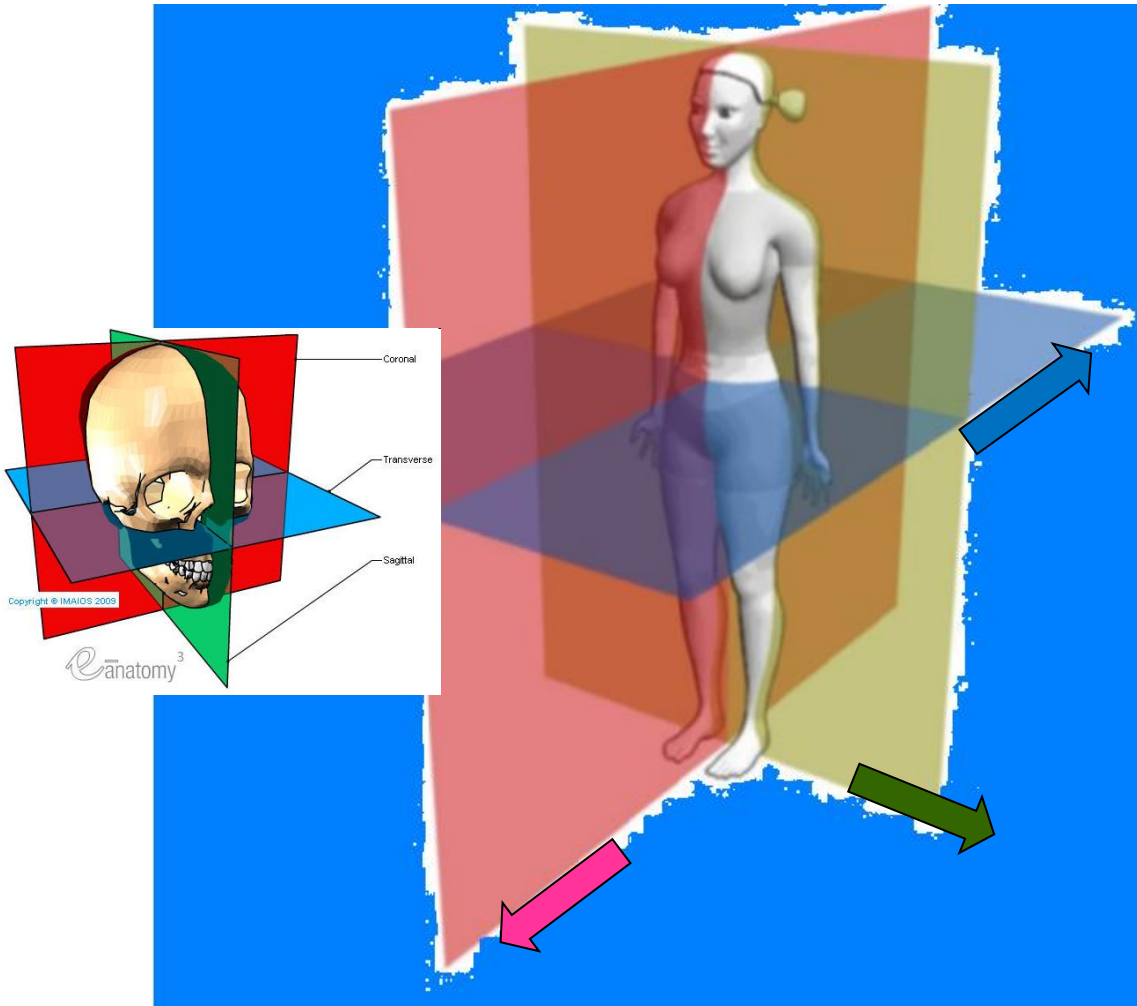
Anatomical position
standard erect position

X



Not a military position!

PLANES – 3 anatomical planes or sections



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



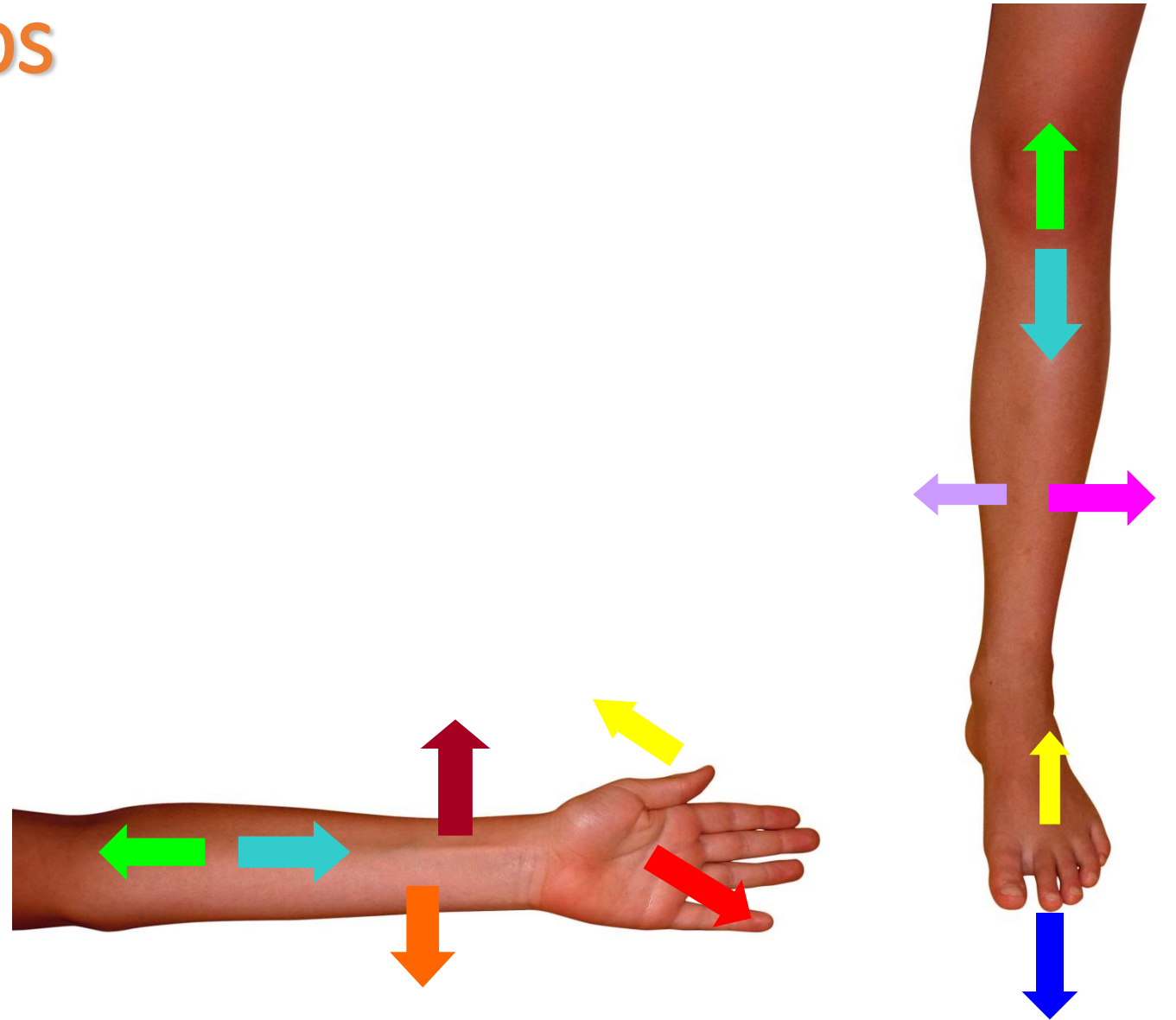
Transverse plane (horizontal, axial, cross sections)
Vertical plane - Superior and inferior
(acc. to transversal axis)

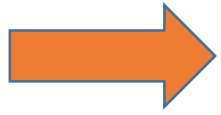


Frontal plane (coronal)
Anterior and posterior
(acc. to longitudinal axis)

Directions at the limbs

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





Are you ok with the directions?

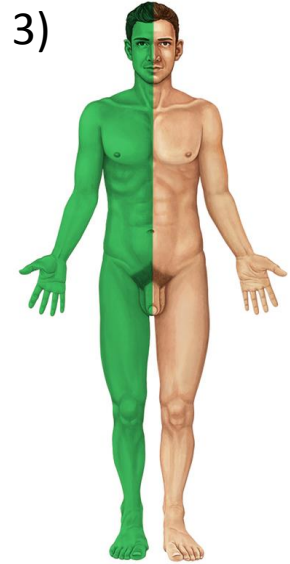
- 1) Which of the following terms is synonymous with the frontal plane?
- a. Axial
 - b. Coronal
 - c. Sagittal
 - d. Transverse
 - e. Cross section

2)



The green arrow faces

3)



The green part of body is

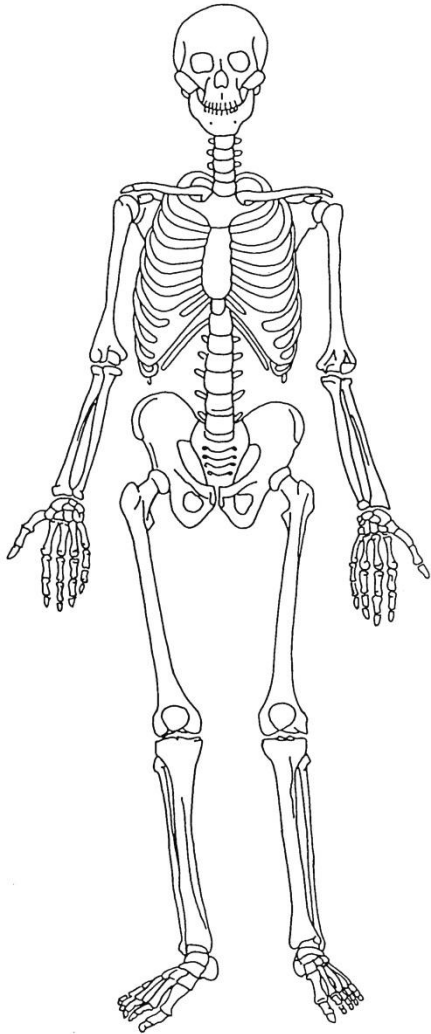
How to describe bones

- 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!!!



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

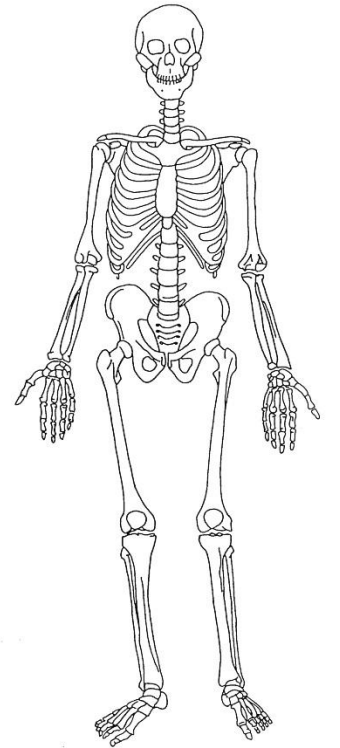
Capitulum – a small head

Collum, cervix – a neck

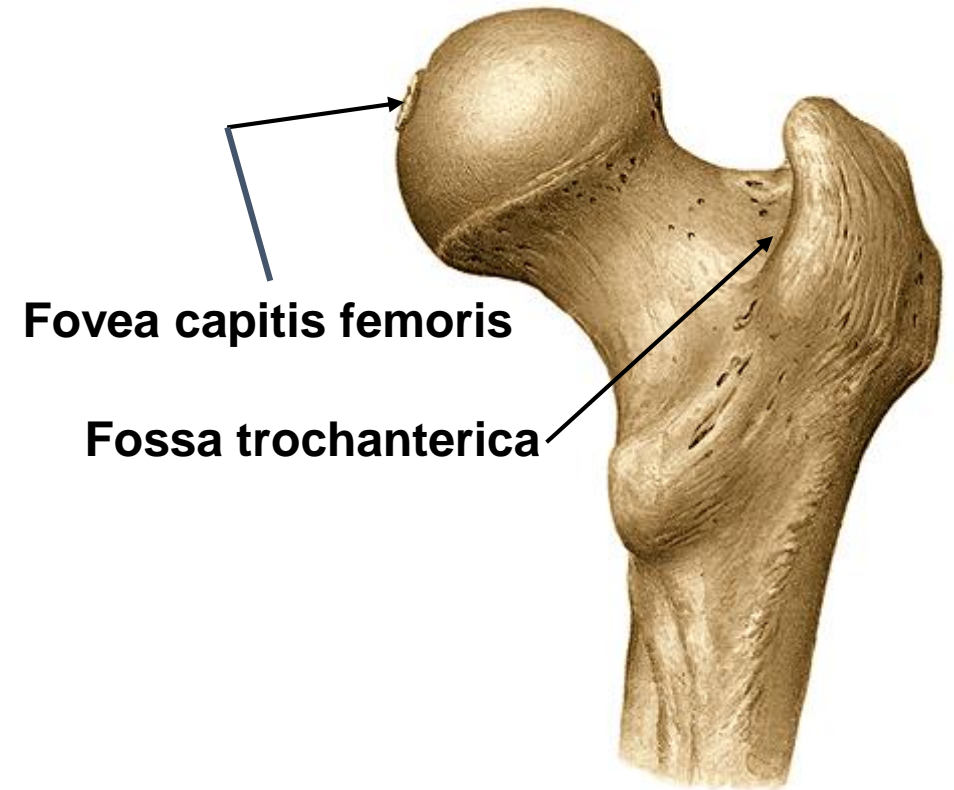
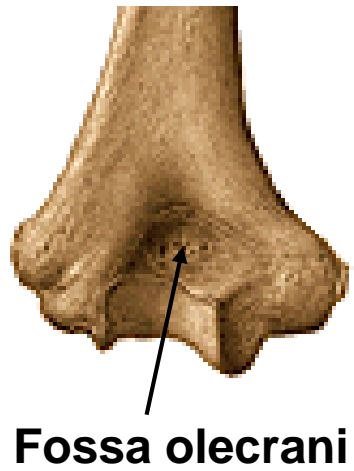
Os, ossis, ossa – a bone, bones

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

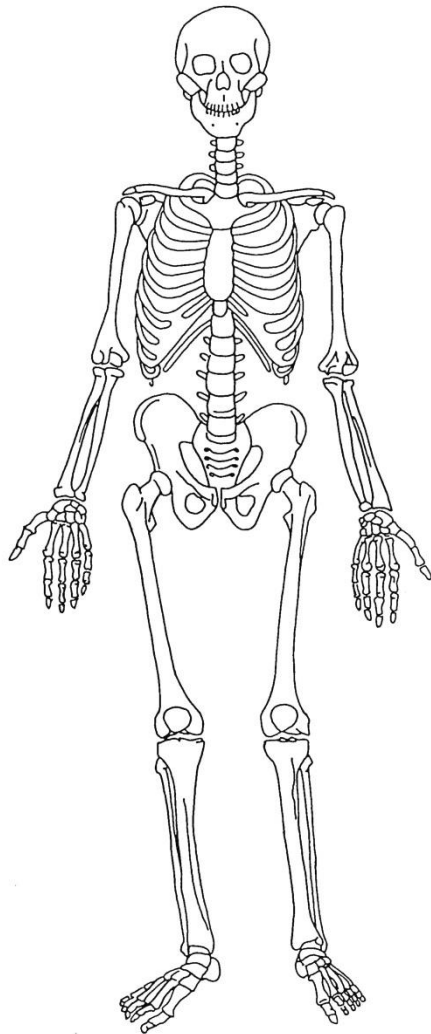
Incisura x foramen

Incisura scapulae



Foramen obturatum





AXIAL SKELETON

Bones of the skull

Vertebral column (spine)

Ribs

Sternum

} Central line of the body (80)

APPENDICULAR SKELETON

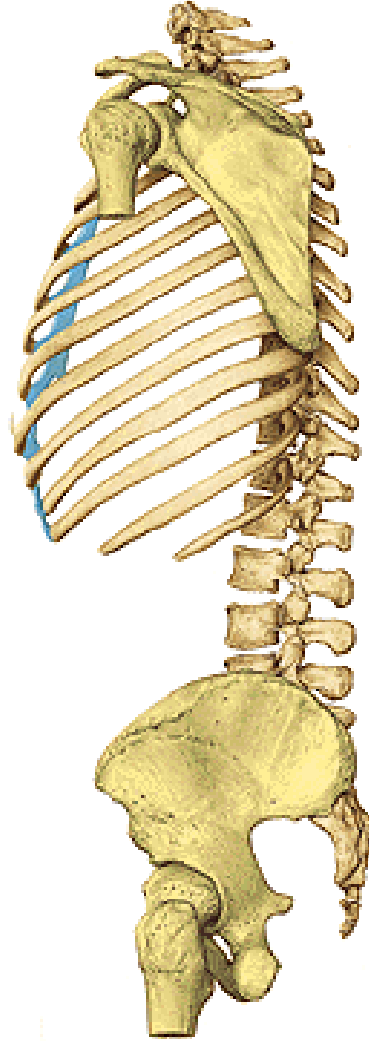
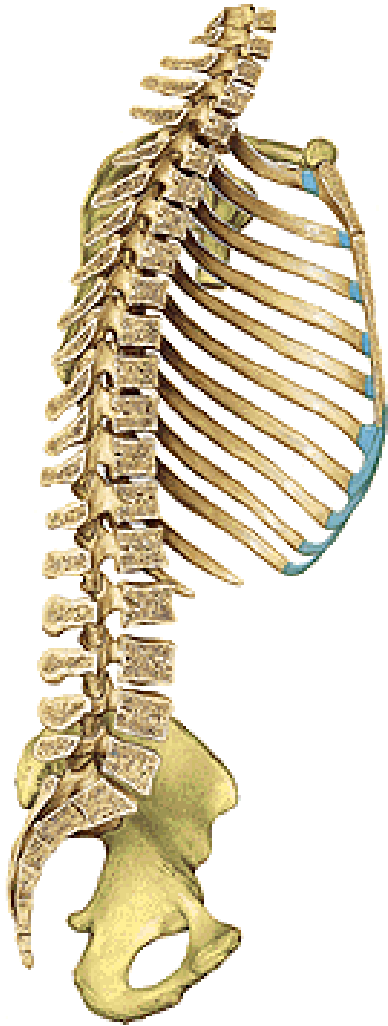
Bones of the limbs

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

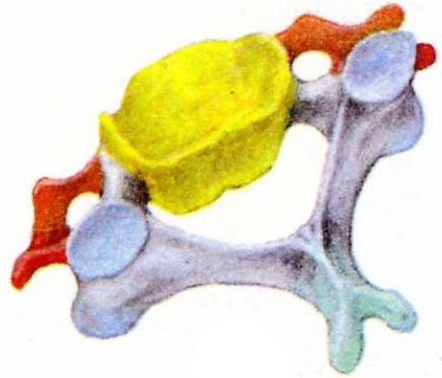
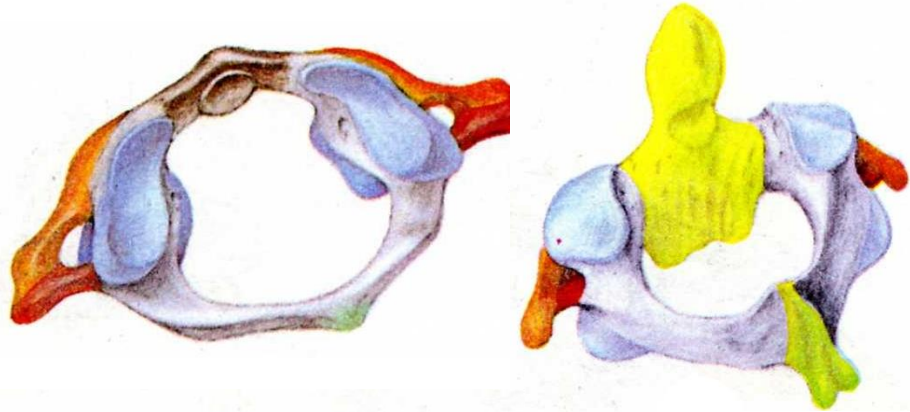
12 vertebrae **thoracicae (Th)** thoracic vertebra

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)

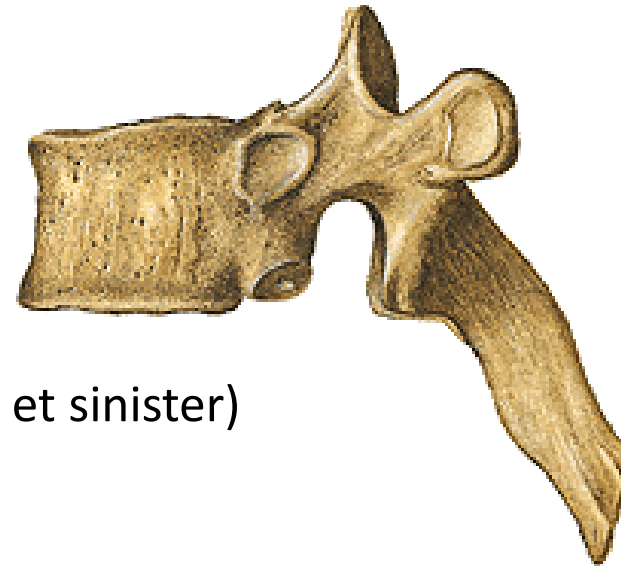
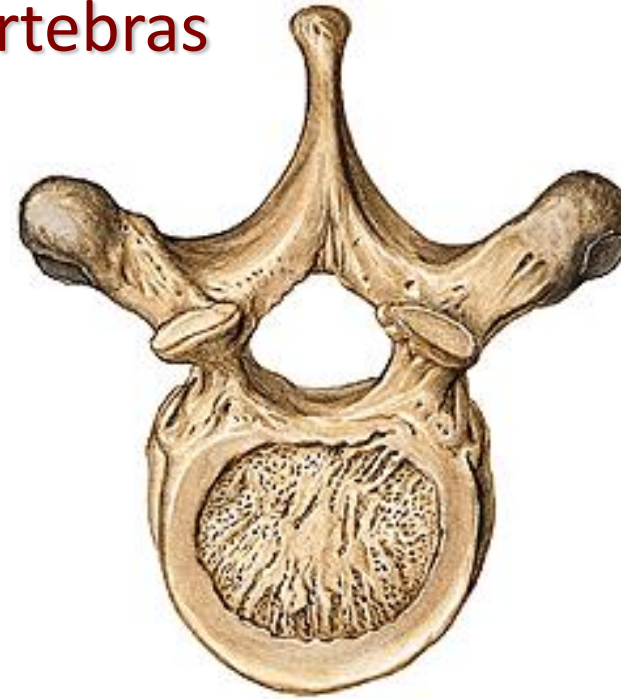
Incisura vertebralis superior et inferior

Foramen intervertebrale

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

2x processus transversus (dexter et sinister)

1x processus spinosus



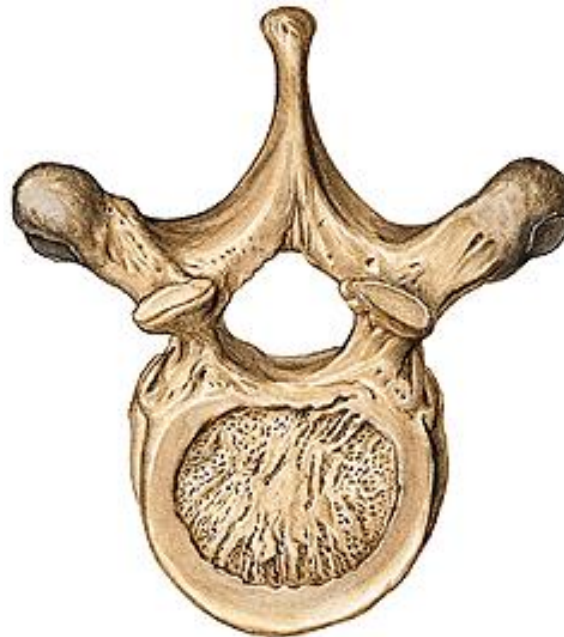
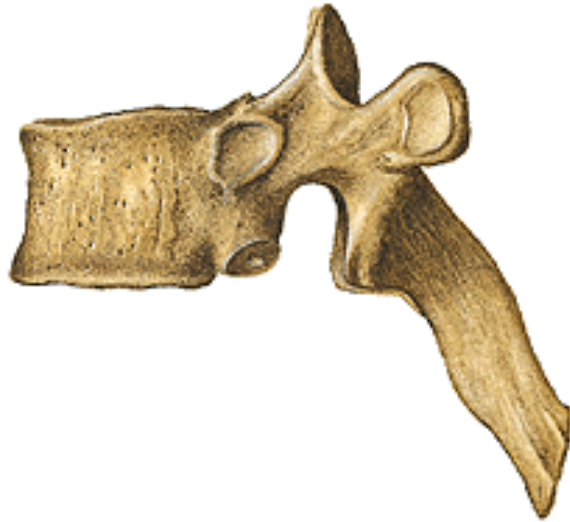
Processus vertebrales

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 C₁ – C₇ (Cervical vertebrae)



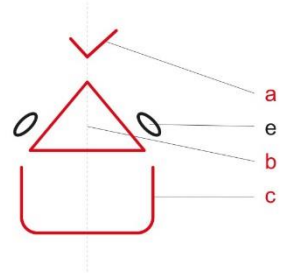
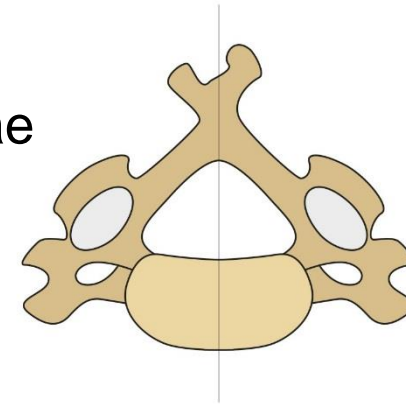
Foramen processus transversi !!!!!

Sulcus nervi spinalis

Tuberculum anterius et posterius processus transversi

Uncus corporis vertebrae

Processus articulares



Bifurcations of the spinous processes (C2 – C6)

C6 - **tuberculum caroticum**

C3 – the smallest body

C7 – **vertebra prominens**

C₁ - Atlas



Arcus anterior et posterior atlantis

fovea dentis

tuberculum anterius et posterius atlantis

foramen vertebrale

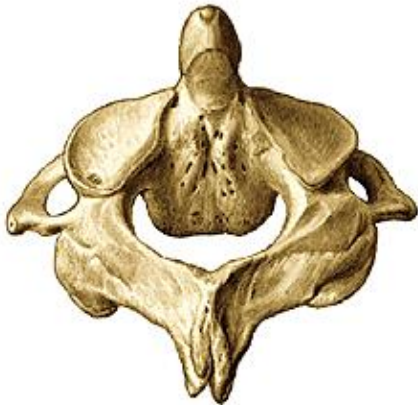
Massae laterales

facies/fovea articularis superior et inferior

sulcus arteriae vertebralis

processus transversi

C₂ - Axis



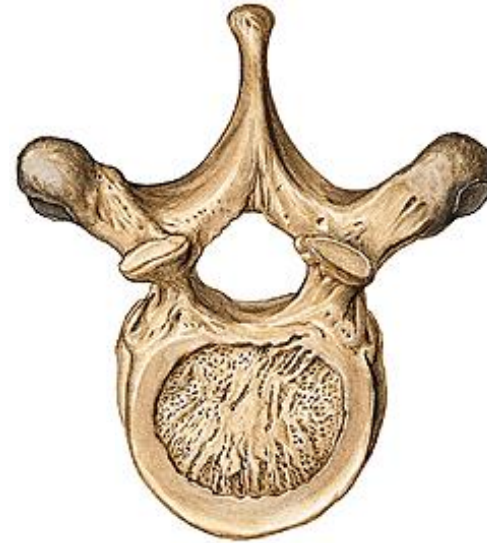
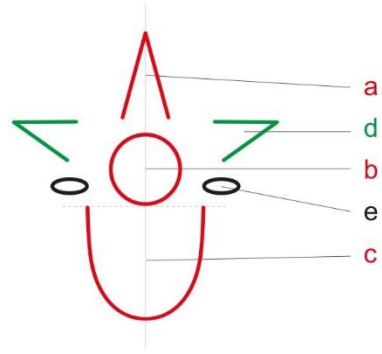
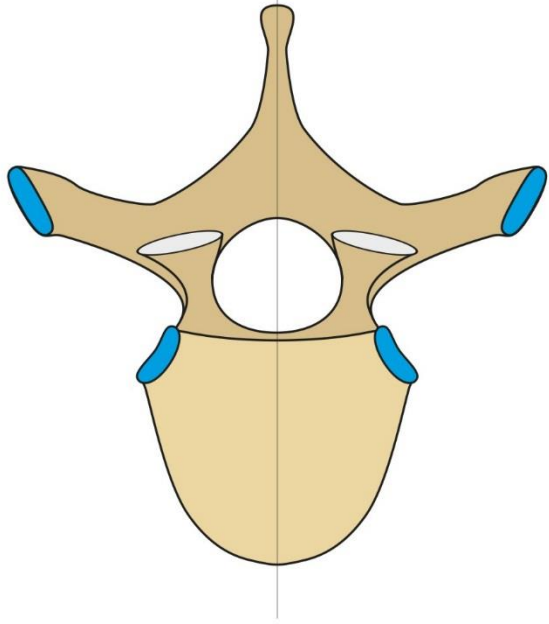
Corpus vertebrae

Dens axis

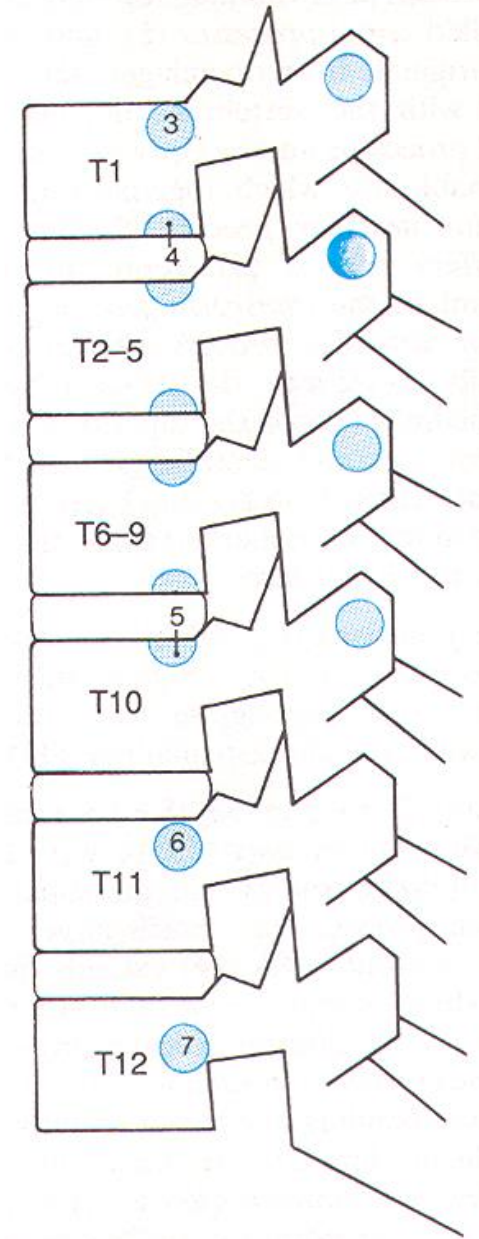
facies articularis ant. et post. dentis

apex dentis

Vertebrae thoracicae Th₁ – Th₁₂ (thoracic vertebrae)



fovea costalis (dextra et sinistra)
fovea costalis processus transversii
processus articulares



Vertebrae lumbales L₁ – L₅ (lumbar vertebrae)



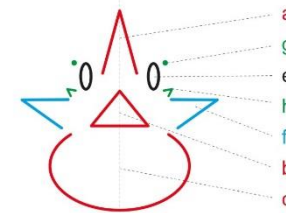
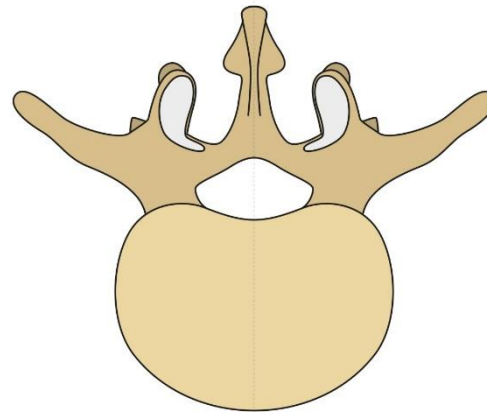
processus costarii

processus mammillares

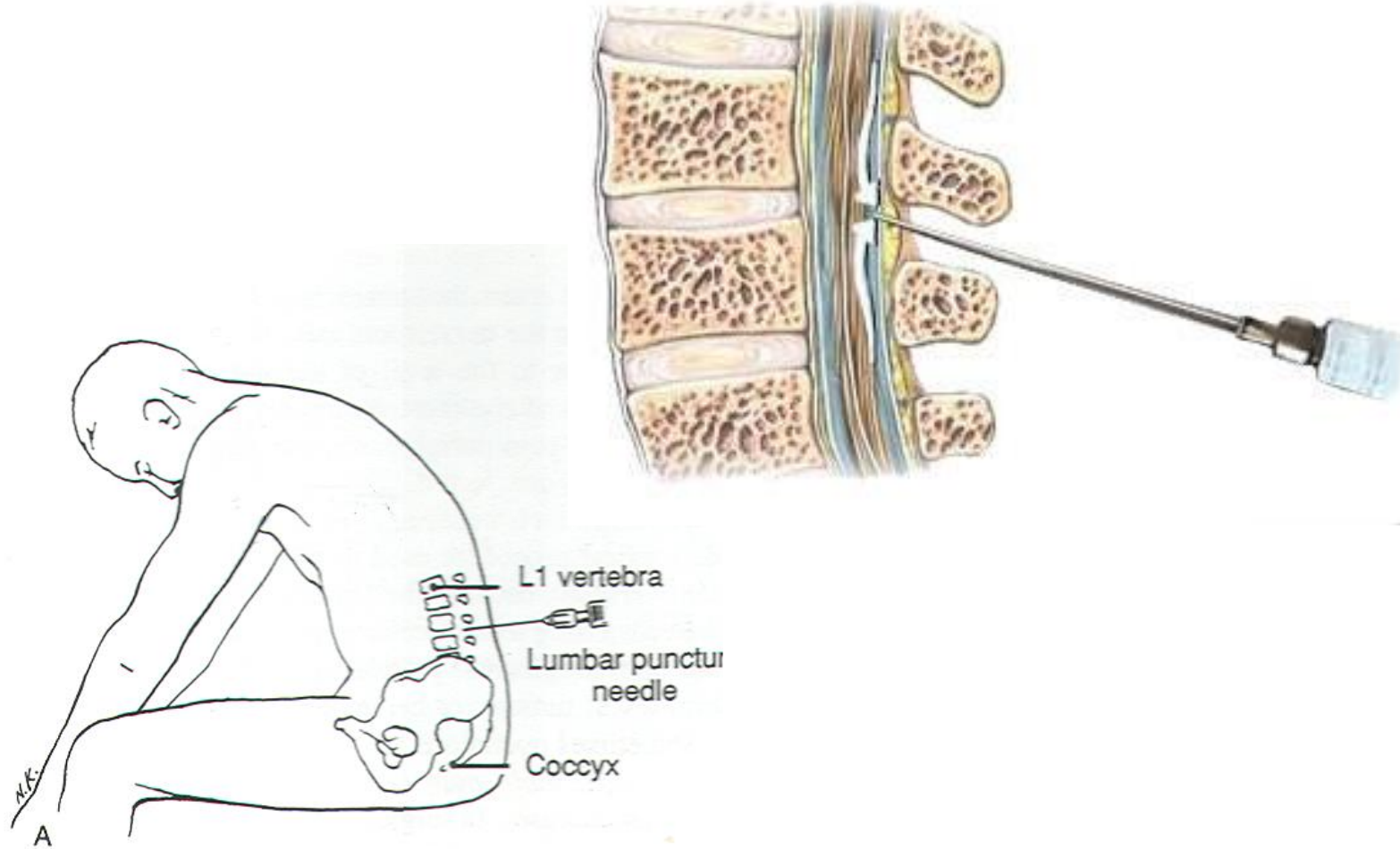
processus accessorii

Processus articulares

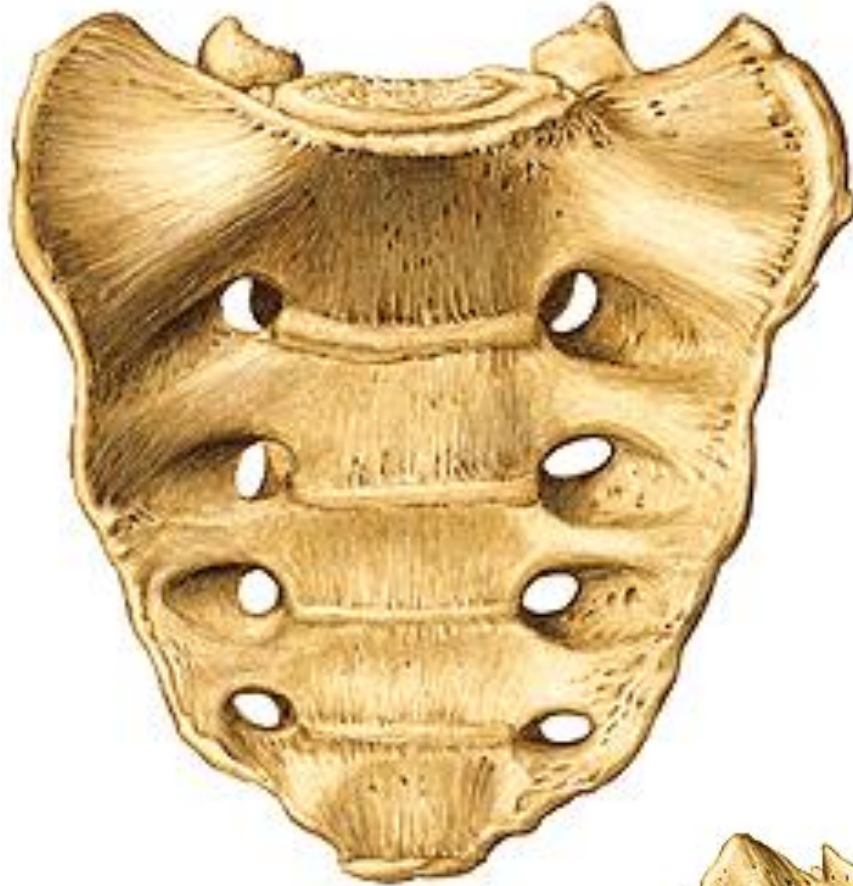
Shape and direction of spinous process



Lumbar puncture - between L₃ – L₄ Cerebral liquor



Vertebrae sacrales, os sacrum (sacral bone)



basis – facies terminalis superior

apex – facies terminalis inferior

facies pelvina

lineae transversales

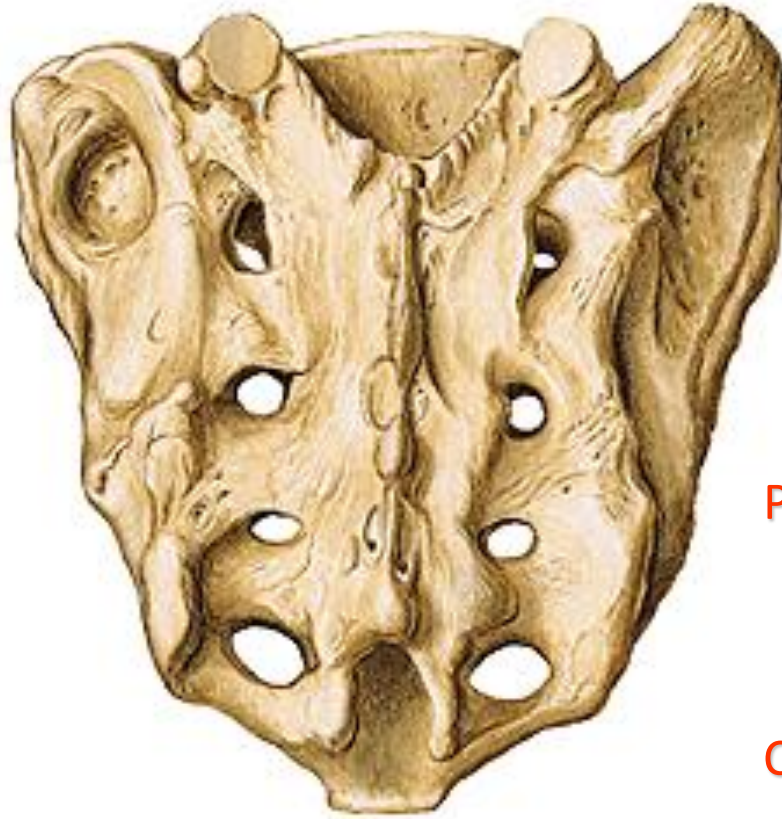
foramina sacralia pelvina

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) (Co₁ – Co₄₋₅)

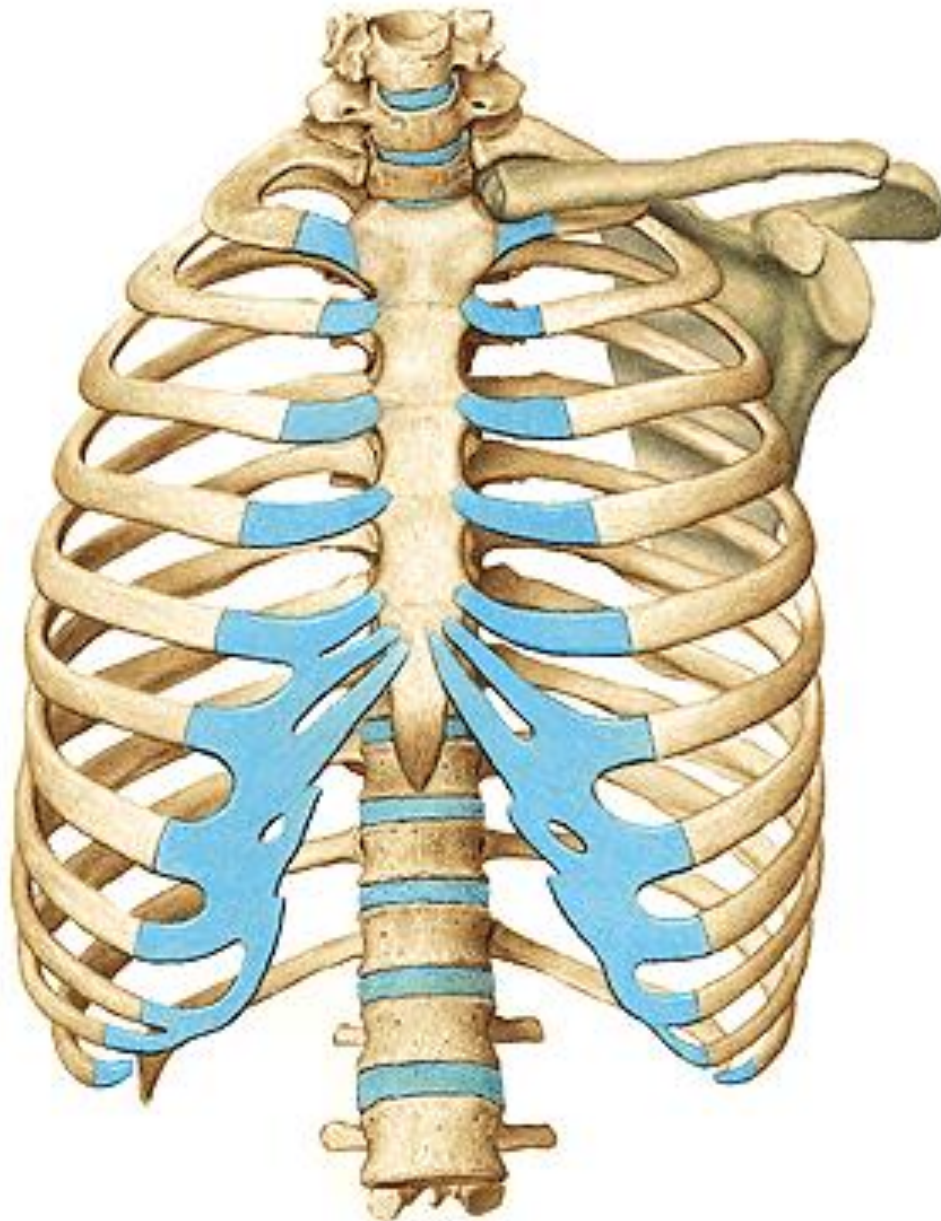


basis – facies terminalis superior

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

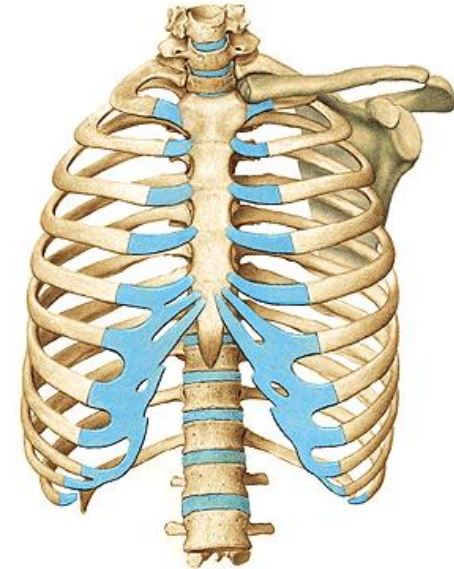
facies articularis tuberculi costae

Corpus

angulus costae

crista costae

sulcus costae





Costa prima

tuberculum musculi scaleni anterioris

sulcus arteriae subclaviae

tuberculum musculi scaleni medii

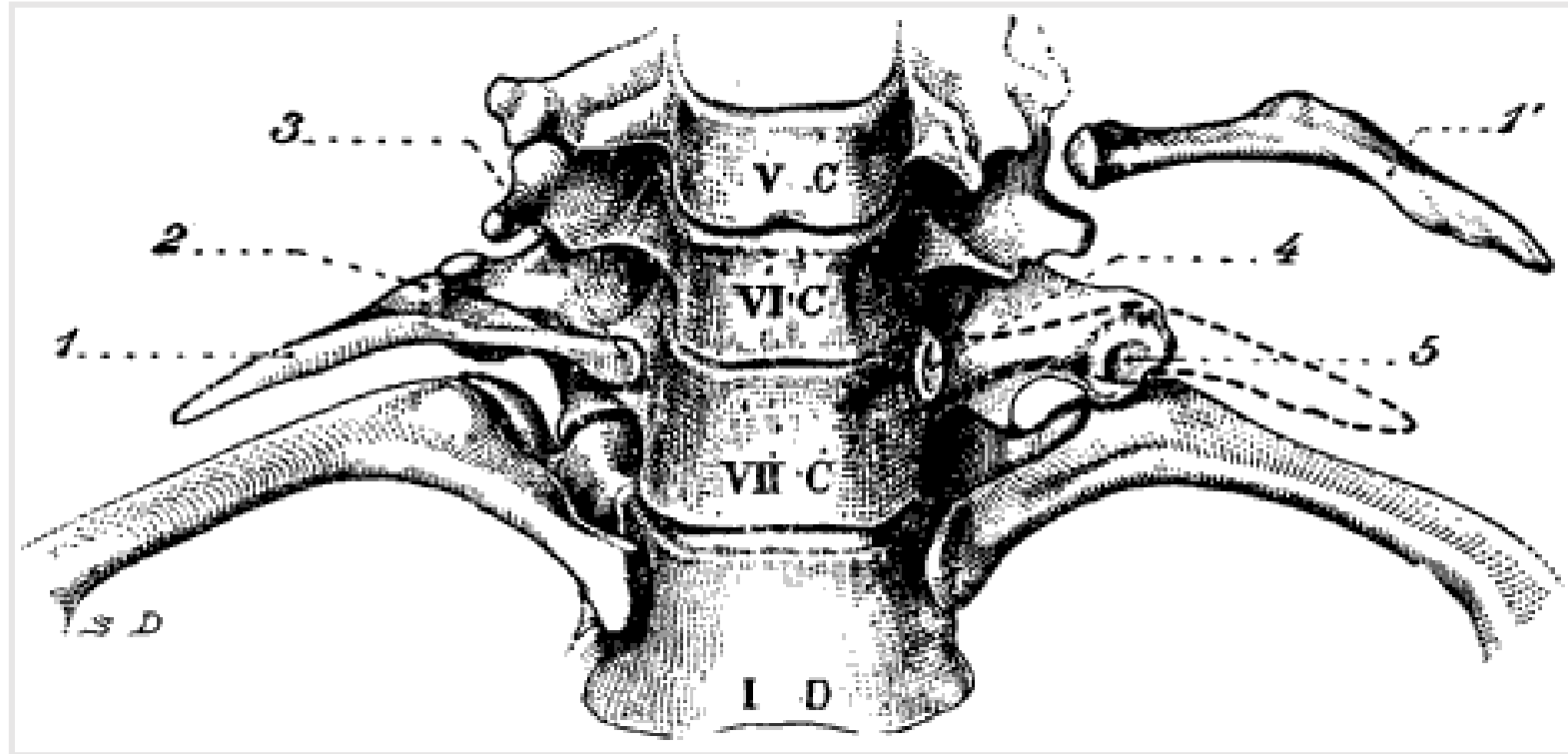
Costa secunda

tuberositas musculi scaleni posterioris

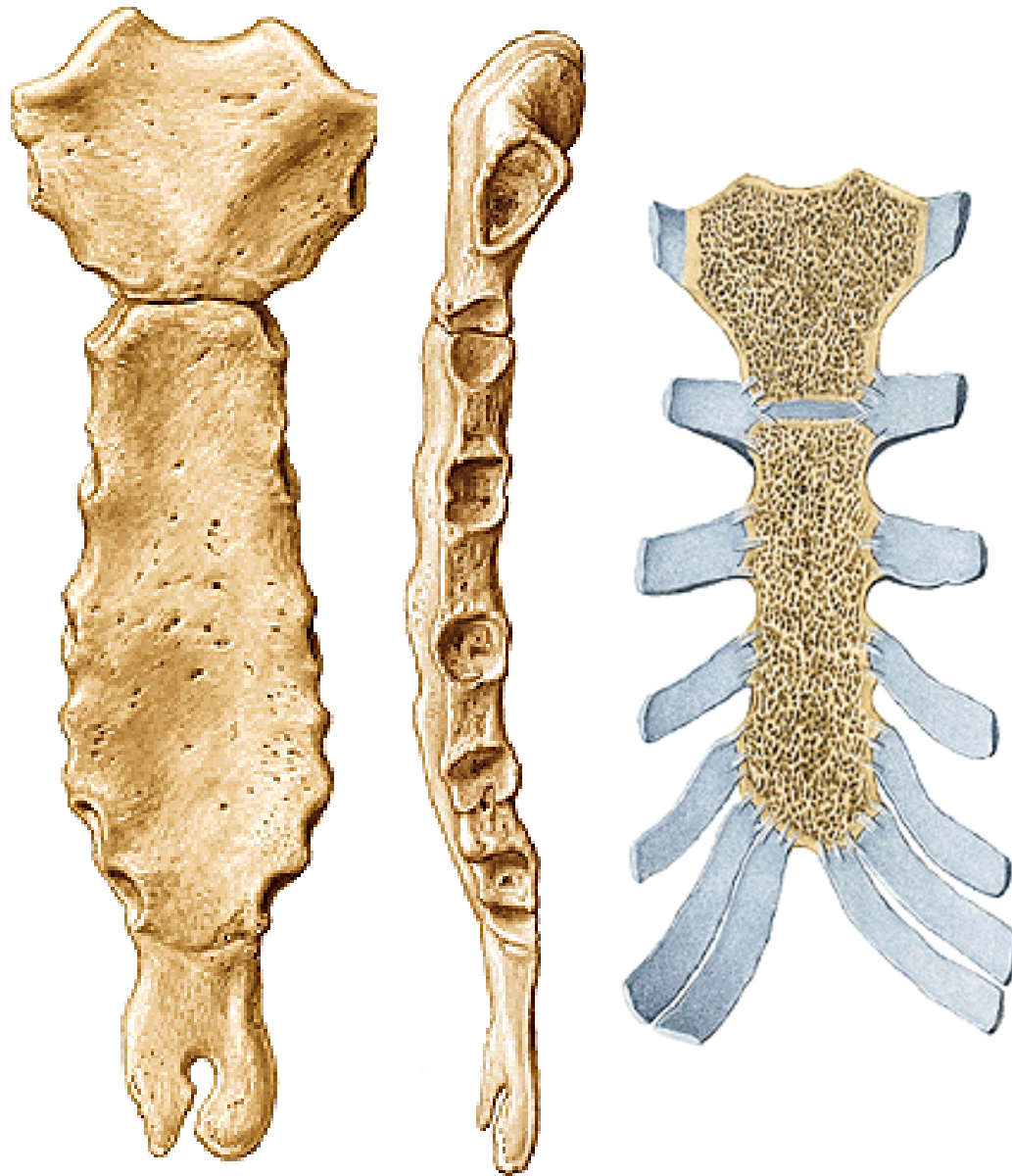
tuberositas musculi serrati anterioris

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

Cervical rib



Sternum (breast bone)



Manubrium sterni

incisura claviculæ

incisura jugularis

incisurae costales 1.,2.

Angulus sterni

Corpus sterni

incisurae costales (3.-7. žebro)

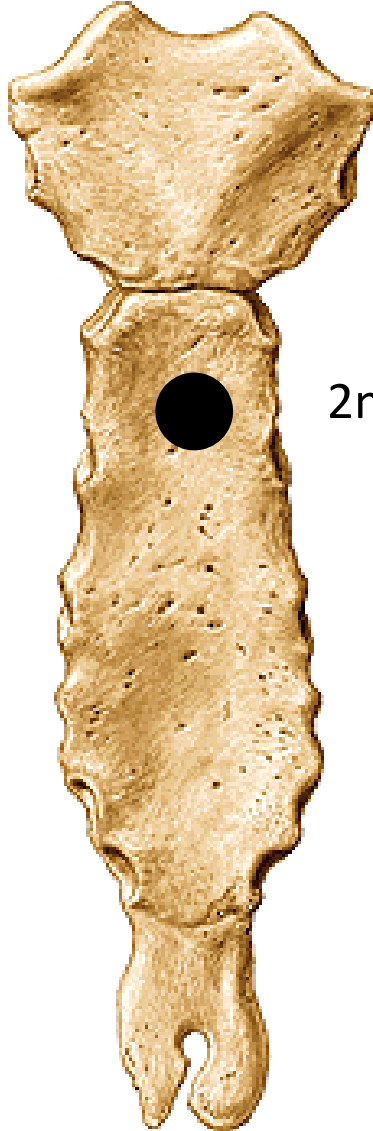
Processus xiphoideus



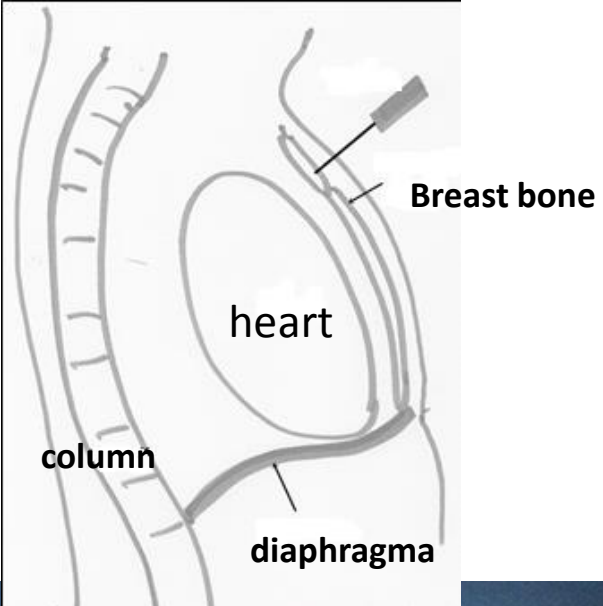
Sternebrae

Hollow in the body of the breast bone

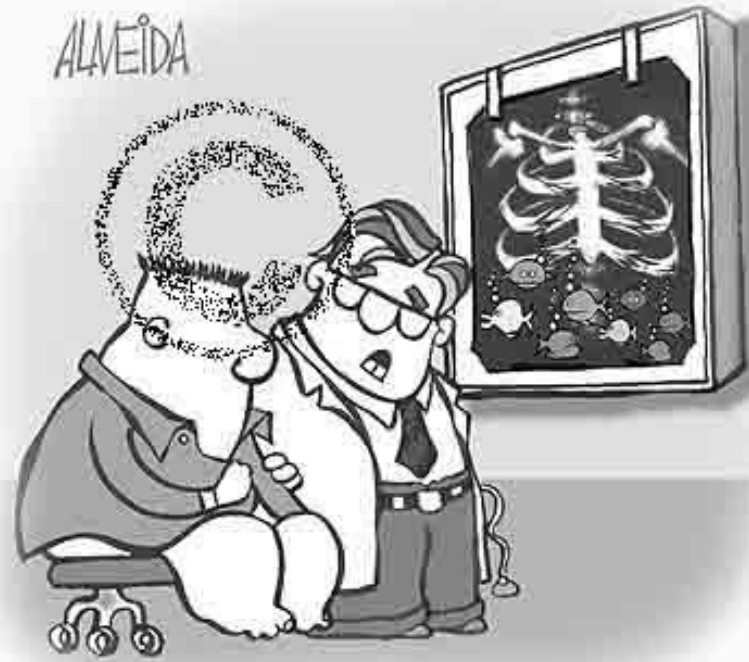
Sternal puncture



2nd intercostal space



ALVEIDA



**"Judging from your X-ray, I'd say
you're not digesting your sushi!"**

X-rays anatomy



**Anatomy is
essential for
understanding
radiology.**

Wilhelm Conrad Röntgen 1845-1923

1895 – discovery of x-ray

1901- awarded by Nobel price in physics

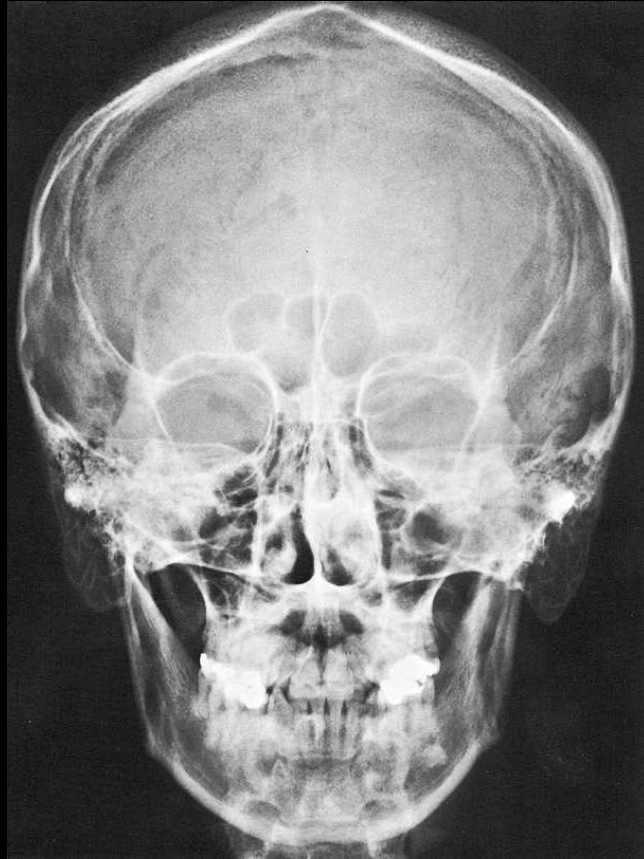


X-rays principle

- A highly penetrating beam of x-rays „transluminates“ the patient, showing tissues of differing densities on x-ray film.
- A tissue or organ that is relatively dense absorbs (stops) more x-rays than a less dense tissue.
- Like a negative
- Light structures –shadows
- Dark structures -brightening

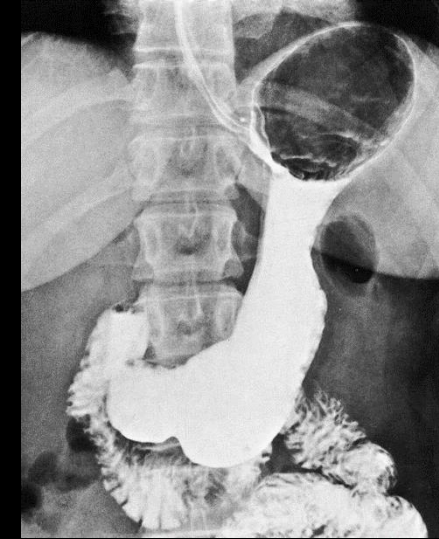


NATIVE x-ray
without using of
contrast agent



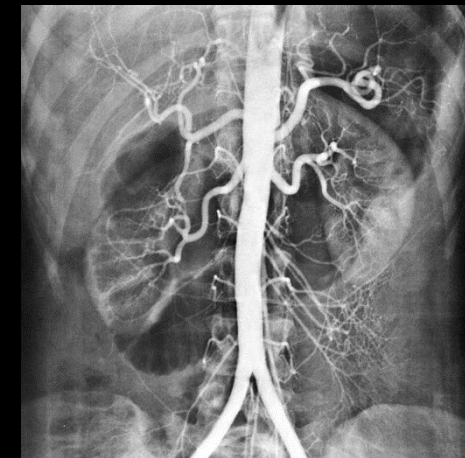
**X-rays with contrast
material** (Contrast
examination)

Negative
Gass, air



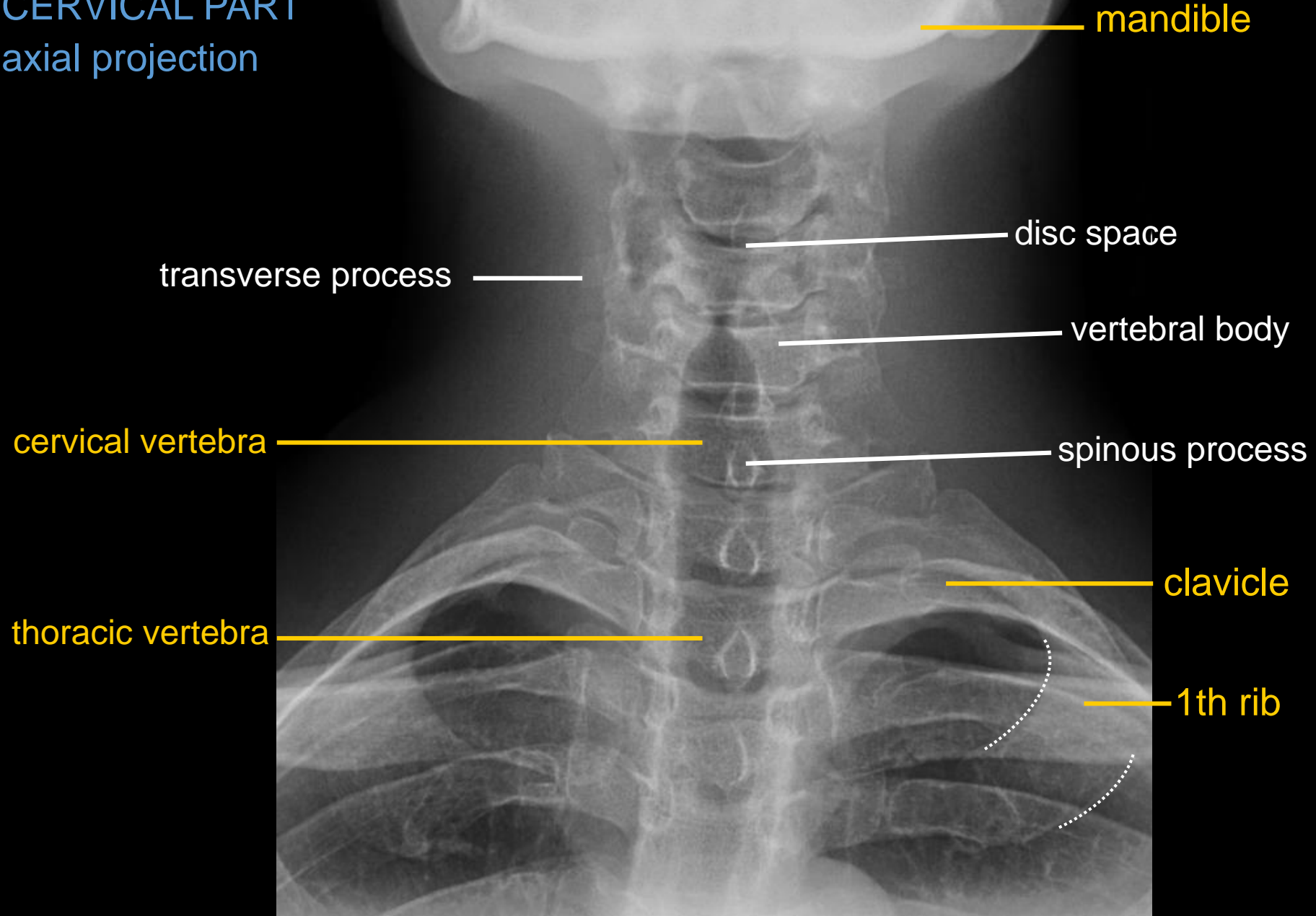
Positive
Barium sulfata

Iodine-based molecules



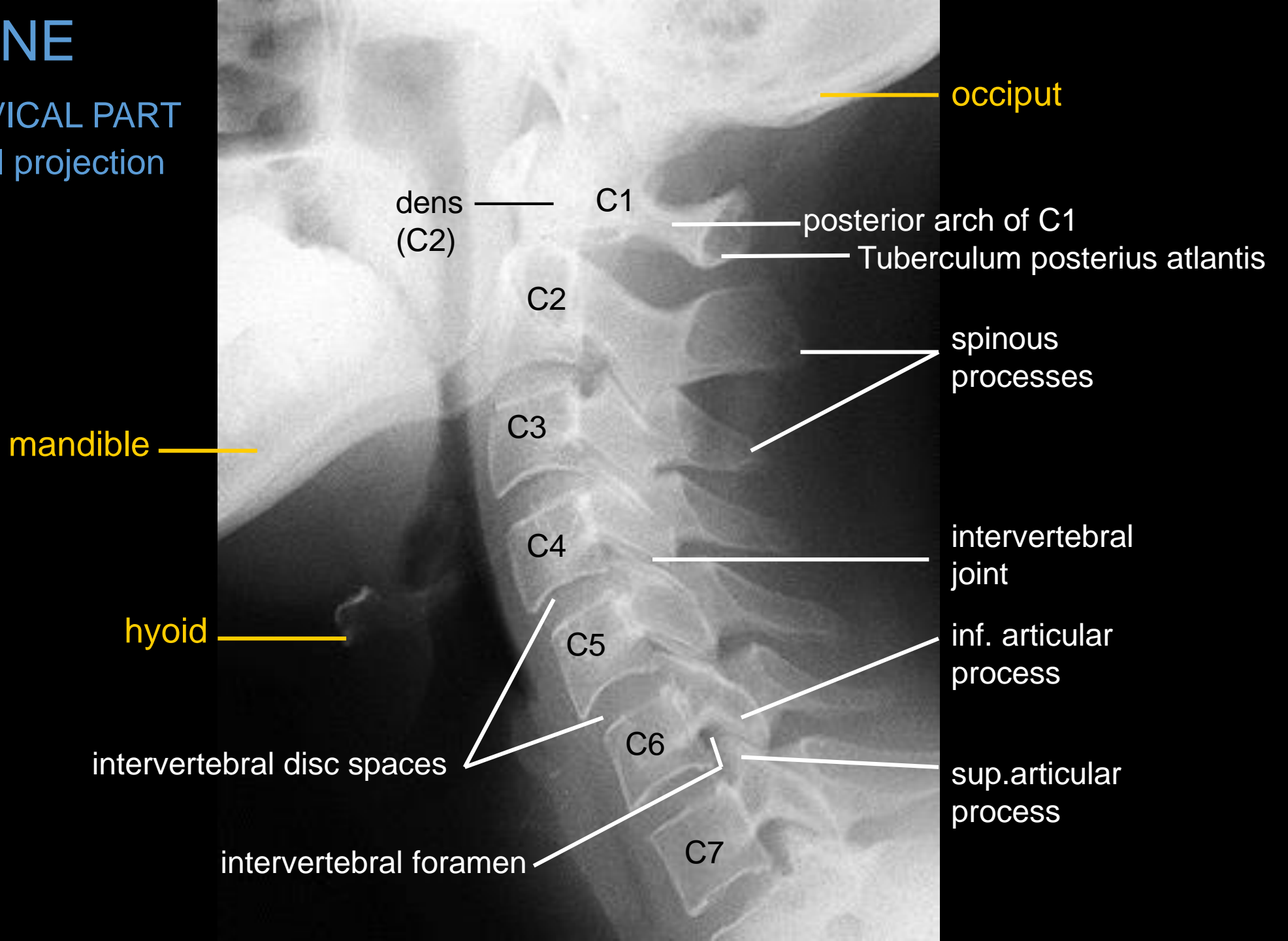
SPINE

CERVICAL PART
axial projection



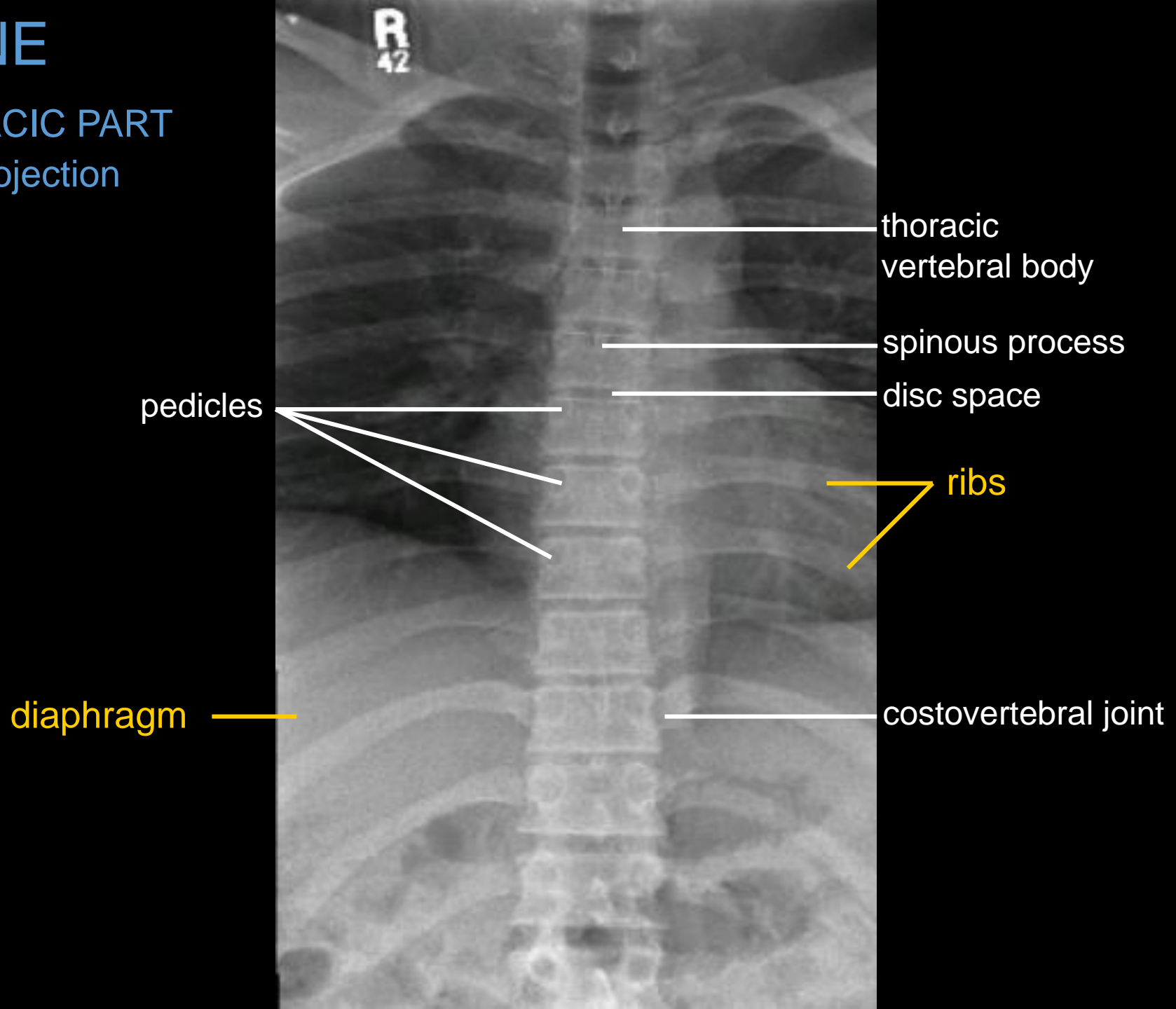
SPINE

CERVICAL PART
lateral projection



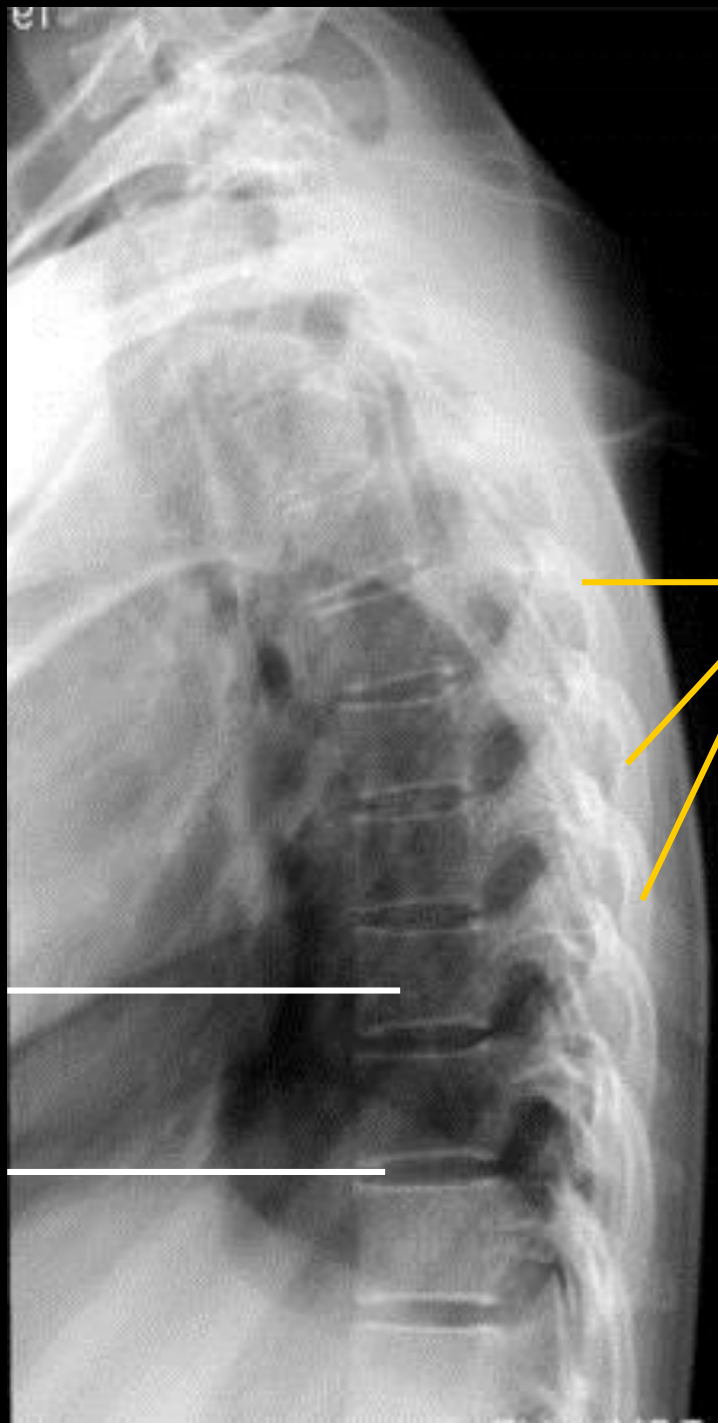
SPINE

THORACIC PART
axial projection



SPINE

THORACIC PART
lateral projection



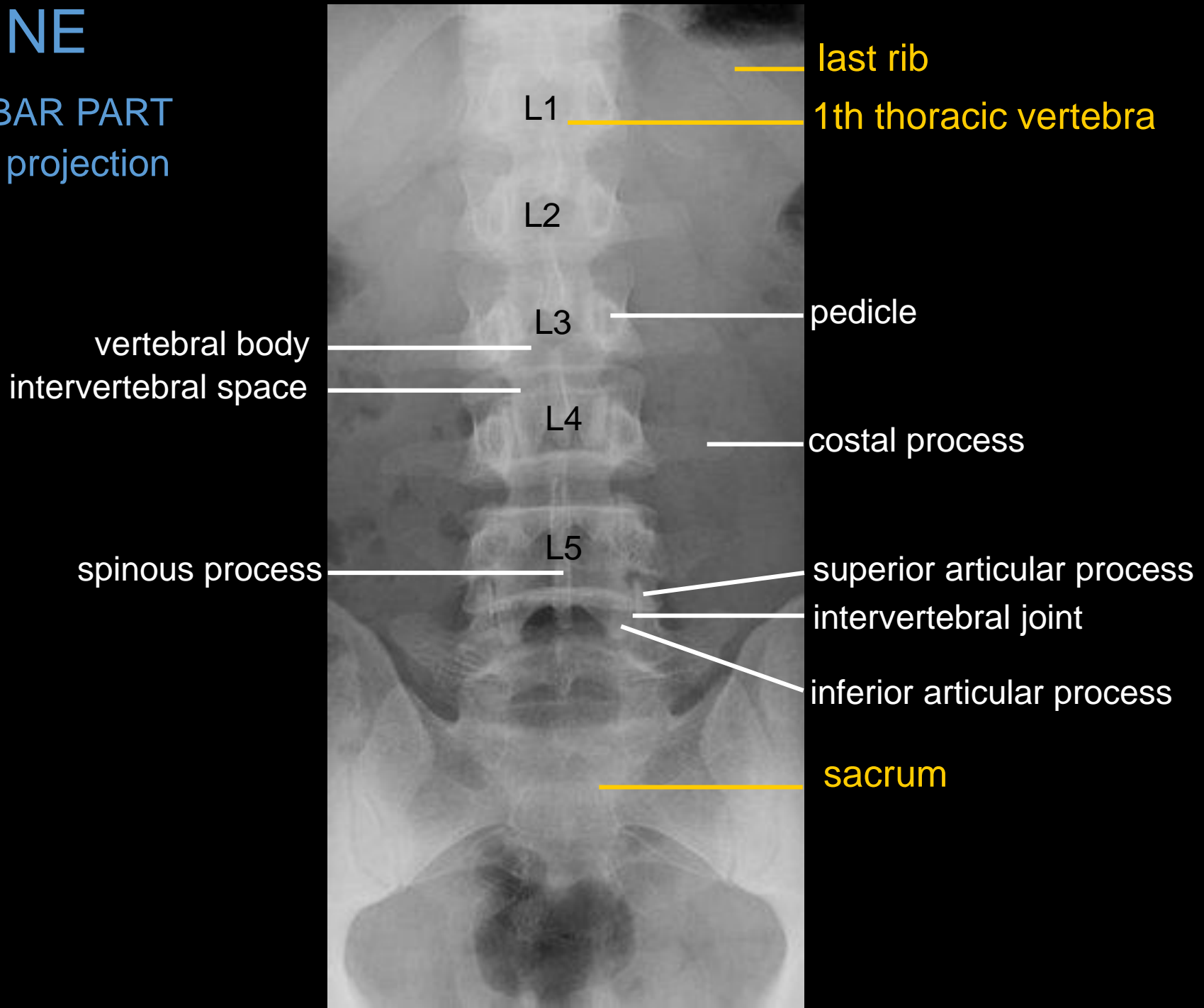
ribs

thoracic
vertebral body

intervertebral
disc space

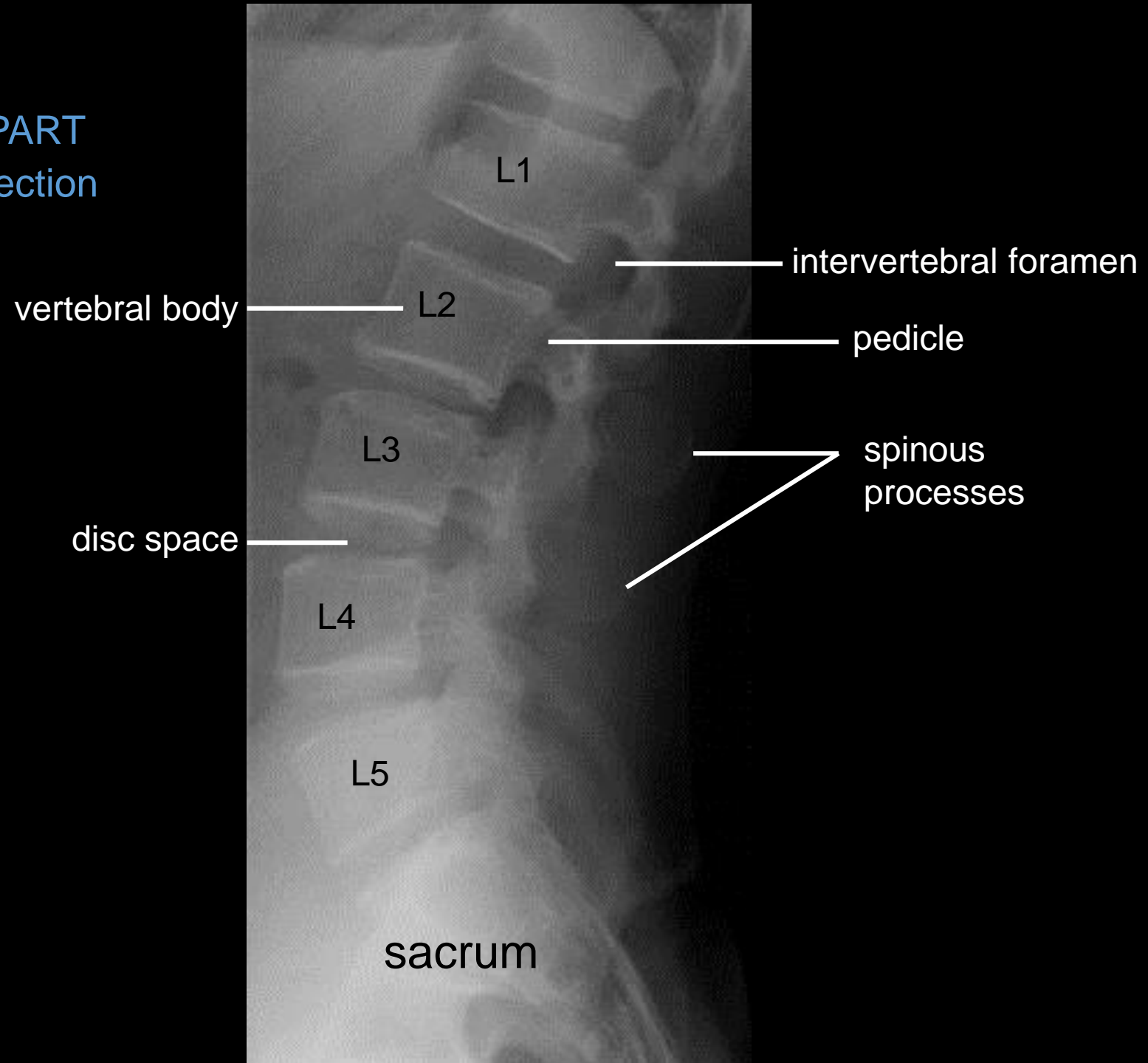
SPINE

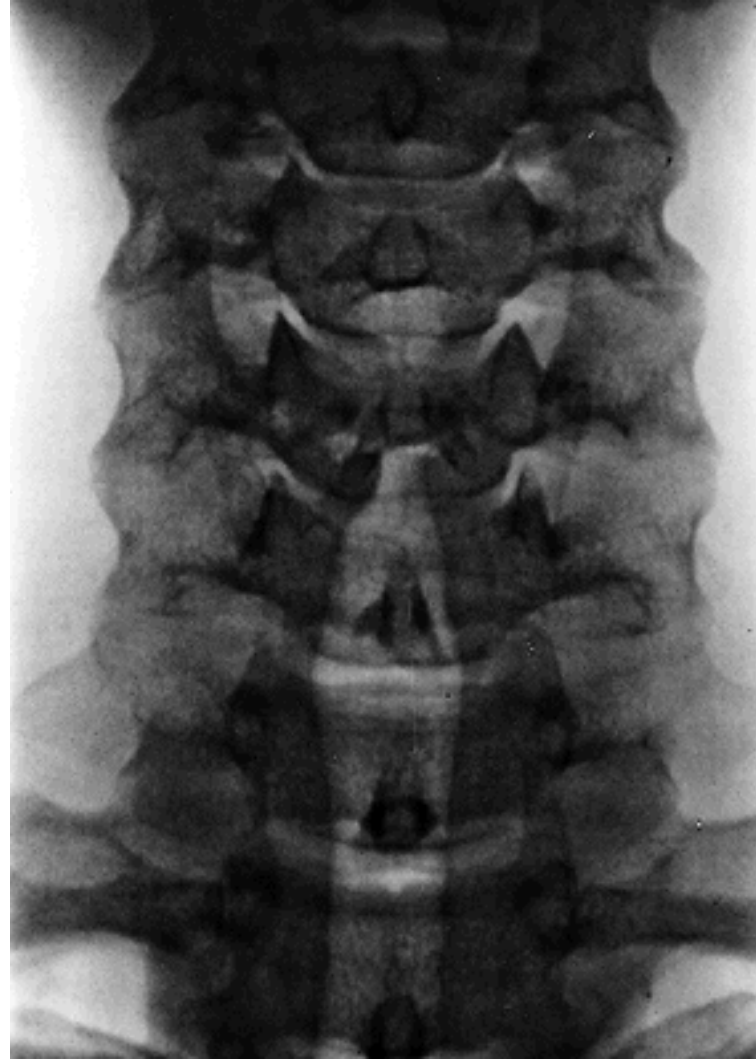
LUMBAR PART
axial projection



SPINE

LUMBAR PART
lateral projection









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**