



Anatomy

HAYAT BATCH

done by : *Jana Salah*

lecture no : 2



General Anatomy

Lecture 2: Bones

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The Skeleton

@ It comprises **cartilages, bones, ligaments & joints**. يشمل الهيكل العظمي:

@ The bones are rigid and heavier than cartilages.

لعظام مقارنة بالغضاريف أثقل وأقوى

@ Cartilages are more flexible and lighter.

بدر اثني الغضاريف مثل الغضروف في شحمة الأذن بينما العظام لا

@ The younger the age, the greater is the contribution of cartilage to the skeleton.

لو نيجي نشوف الهيكل بتاع الطفل حنلاقي عنده cartilage كتير، فكلما تقدم الشخص بالسن تحولت cartilages الى bones وبالتالي ال cartilages أكثر عند الأصغر سنًا w

@ Divisions of the skeleton:

1. **Exoskeleton:** rudimentary in man. It is represented by:

Primary

مينا الأسنان البيضاء

nails & enamel of teeth.

وفي حيوانات أيضًا فيها exoskeleton مثل السلحفاة



2. **Endoskeleton:** about 206 bones & is formed of:

a. **The axial skeleton.** الهيكل المحوري

b. **The appendicular skeleton.** الهيكل الطرفي

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A. Bones

حيث يشمل

Bones
Cartilage
Fibrous tissue
Adipose tissue

@ Bones form a hard type of connective tissue. Its hardness is due to its content of calcium.

@ Composed of:

1. Living cells (osteocytes). Osteo = bone Cytes = cells تسيح هذه الخلايا في وسط (جزء عضوي) يسمى

2. Intercellular collagenous matrix (organic component). وهذا الوسط عبارة عن collagen

3. Cement substance and mineral salts (inorganic component). مادة تلتصق ال structures مع بعض

Classification according to the region:

@ **Regional classification of bones:** The human skeleton is divided into:

1. **Axial skeleton:** which includes skull, vertebral column, ribs & sternum.

2. **Appendicular skeleton:** which includes the bones of the appendages (upper & lower limbs) & their girdles (shoulder & pelvic). Limbs

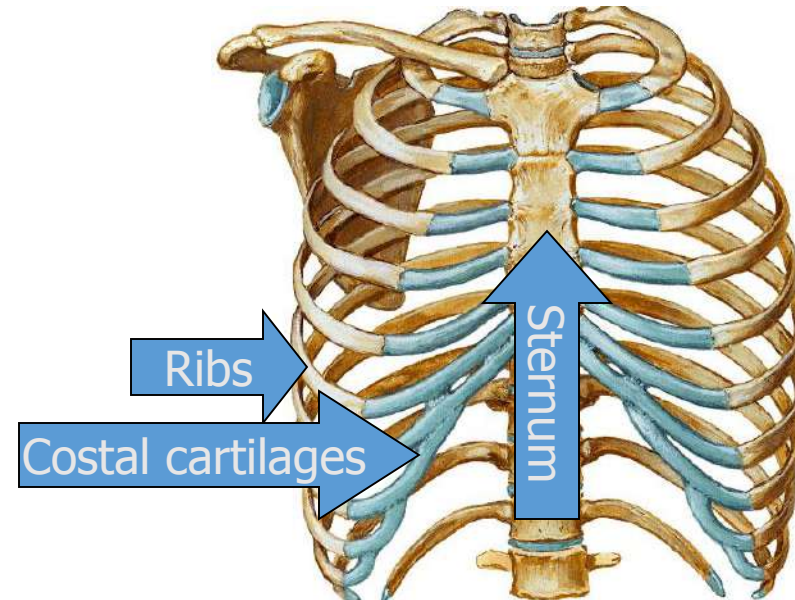
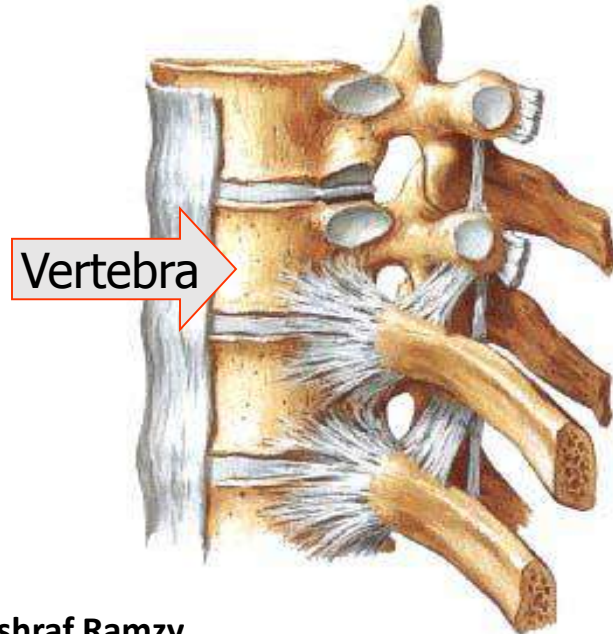
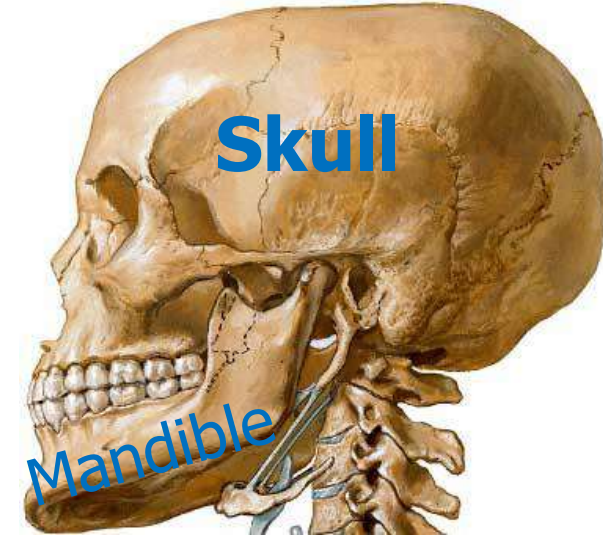
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1. Axial skeleton

الفك السفلي

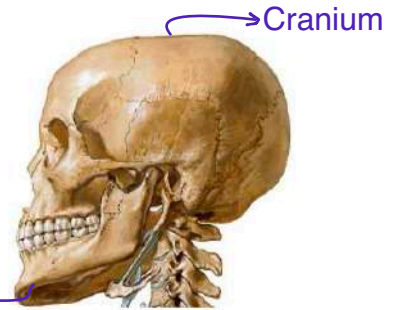
1. Skull & mandible.
2. Ribs.
3. Sternum.
4. Vertebral column.

امشي
بالترتيب
بتحفظهم



@ **The skull (cranium)** (which contains the brain + its meninges) + **the mandible** (part of facial bones) → form the skeleton of the head.

Mandible ←



Skull = cranium + mandible

هي الأغشية السحائية المحيطة بالمخ Meninges

#الفك جزء من عظام الوجه

@ **Ribs (12 pairs)** + their costal cartilages & sternum form the thoracic cage.

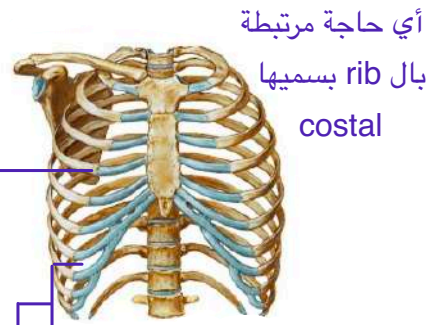
bone ليس cartilage عن عبارة مع ال sternum هو عبارة عن

costal cartilage وبسميه

costal cartilage لما يقرب ال rib من ال sternum بتحوّل إلى

حتى هنا ال rib مش واصل ال sternum لكن ال medial part بتاعه عامل ايه ؟

costal cartilage



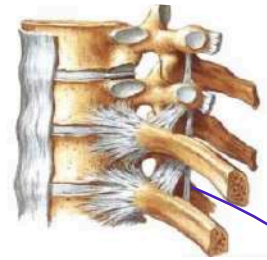
@ **The vertebral column:** is formed of a series of bones called vertebrae (which are 33 vertebrae).

رابط ال ribs من الخلف

@ The vertebrae articulate together by white fibrocartilagenous intervertebral discs.

ما بين

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بين كل vertebrae والثانية في

White fibrocartilagenous intervertebral disc وهو عبارة عن خليط بين ال cartilage & fibrous tissue

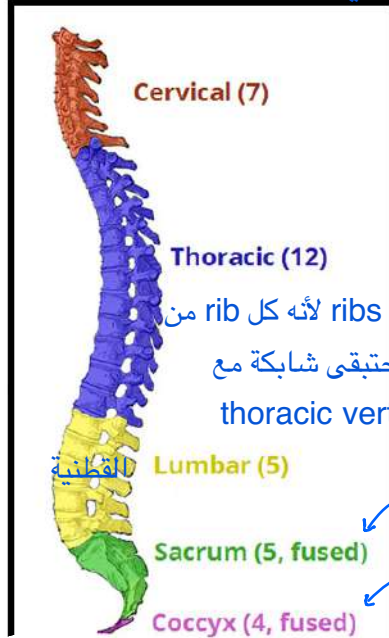
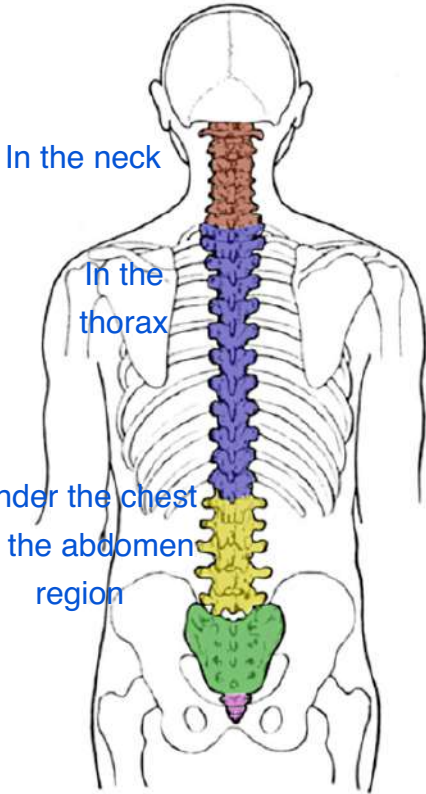
⚠ ساعات ال disc دي بتتحرك من مكانها فبتسبب ضغط على الأعصاب وبتعمل pain فبنسميه مرض

ال disc / الإنزلاق الغضروفي لأن ال discs دي مصنوعة من cartilage

@ The column is divided into 5 regions:

7 cervical - 12 thoracic - 5 lumbar - 5 sacral ^{عجزية}
 (fused to form the sacrum) - 4 coccygeal
 (fused to form the coccyx).

العمود الفقري يبتدي من تحت ال skull
 على طول يوصل لغاية اخر الظهر لآخر جزء
 فيه اللي هو ال coccyx



Cervical (7)

Thoracic (12)

Lumbar (5)

Sacrum (5, fused)

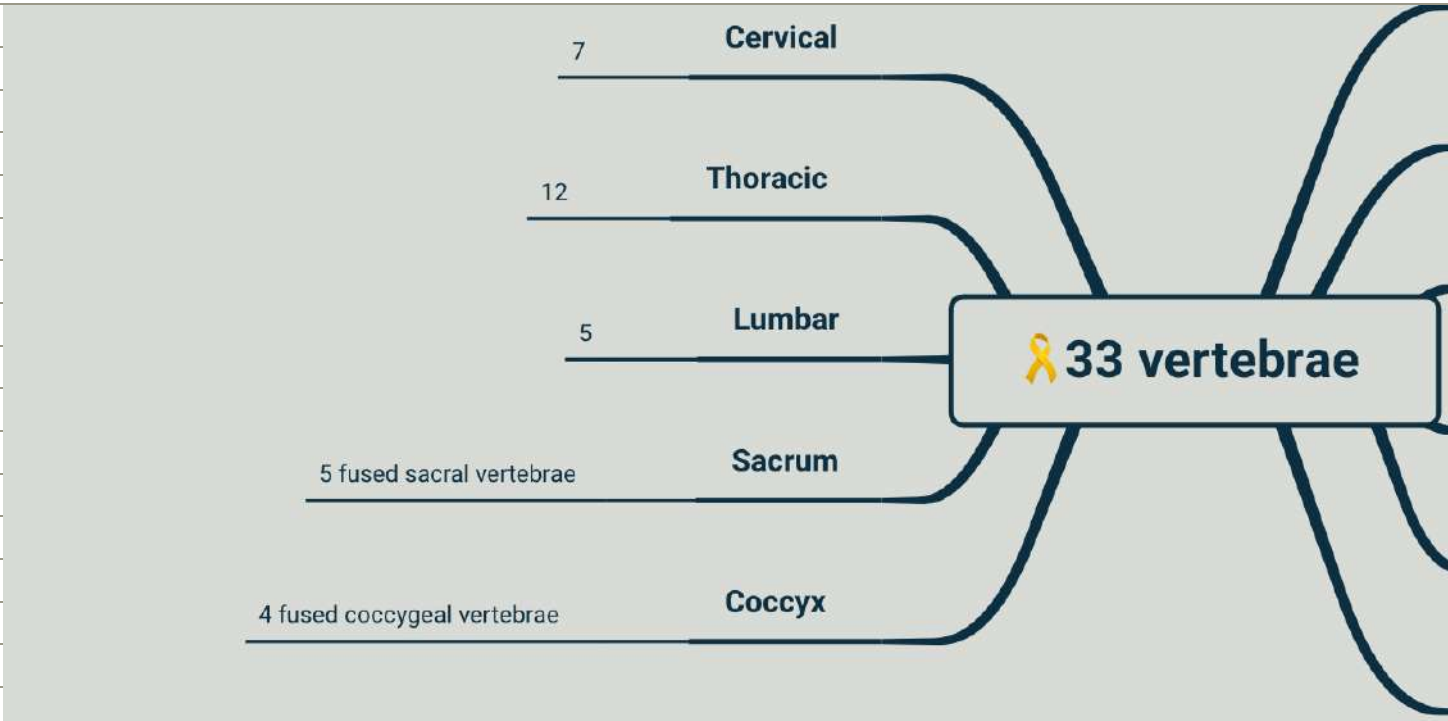
Coccyx (4, fused)

نفس عدد ال ribs لأنه كل rib من الخلف حتبقى شابكة مع thoracic vertebrae

الفطنية

So the sacrum is formed from 5 fused sacral

Coccyx is formed from 4 fused coccygeal vertebrae

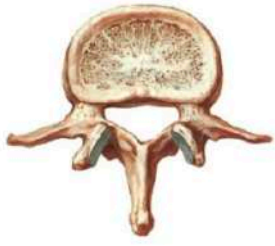


Important Note

كل ما نزلنا بالفقرات لأسفل حجم ال vertebrae يزيد لأنه بحمل وزن أكثر بالتالي لازم يكون حجمه أكبر عشان يتحمل

@ The vertebral column: *Functions*

1. Forms the axial skeleton of the body.
2. Supports the weight of the body.
3. Protects & surrounds the spinal cord.



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الهيكل الأساسي بتاع الجسم

يحمل وزن الجسم ولما يوصل وزن الجسم لعنده بنزل على باقي أجزاء الجسم للضغط السفلي يمينا ويسارا بتوزع على ال right & left lower limbs

قلنا ال vertebral cavity تحتوي داخلها على ال spinal cord فوظيفتها تبقى حمايته ودعمه

** Vertebral column has special curves :-

** Curves of vertebral column:

* **Primary curve:** The vertebral column is concave anteriorly at birth.

* **Secondary curves:** بتحصو بره صا تره

(a) **The cervical curve:** becomes convex anteriorly when the child extends his head at the 3rd - 4th month.

(b) **The lumbar curve:** becomes convex anteriorly when the child begins to walk between 12-18 months due to strengthening of the muscles of the back.



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الجنين في بطن امه يكون عموده الفقري كله concave anteriorly لأنه طول الوقت بيطن امه وهو راسه لتحت ورجليه ل فوق وظهره على بطن أمه يعني ظهره للأمام والبطن عند الأم convex anteriorly بس بالنسبة للطفل حيبقى ظهره convex posteriorly وبالتالي هو في البداية ال vertebral column بتبقى استدارته من استدارة الرحم بتاع الأم ويكون كله concave anteriorly

في الشهر الثالث والرابع بيتدي الطفل يرفع راسه، لما يرفع رأسه ويسبب ثقل الرأس the cervical part of the vertebral column will convex anteriorly

بعد سنة - سنة ونص ابتدي الطفل يمشي فوزن الجسم بنزل على ال lumbar vertebrae فيبقى convex anteriorly

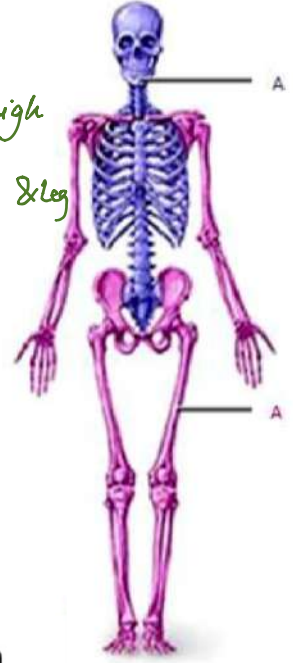
Thoracic and sacrum vertebrae remain concave anteriorly احتفظوا بال concavity بينما ال Cervical & lumbar vertebrae صاروا convex anteriorly وسبقناهم Secondary curves

2. Appendicular skeleton

@ The skeleton of the upper limb resembles that of the lower limb; each consists of 3 segments:

1. **Proximal segment:** formed of one bone. *Arm & Thigh*
2. **Intermediate segment:** formed of 2 bones. *Forearm & leg*
3. **Distal segment:** formed of 3 regions. *Hand & Foot*

<u>Upper limb</u>	<u>Lower limb</u>	
-Arm	-Thigh	→ 1 Bone
-Forearm	-Leg	→ 2 Bones
-Hand	-Foot	→ 3 Regions



@ Each limb is connected to the axial skeleton by a ^{حزام}girdle (formed of 2 bones in the upper limb & 1 bone in the lower limb).

أكید مش حسیبه کنه طایر لوحده

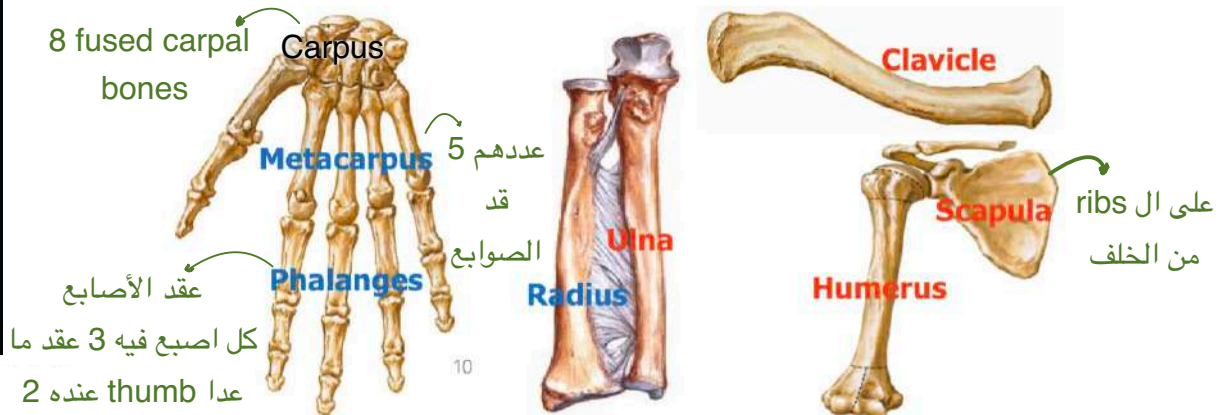
Shoulder girdle connect upper limb with axial skeleton

Pelvic girdle connect the lower limb with axial skeleton

@ Bones of Upper limb:

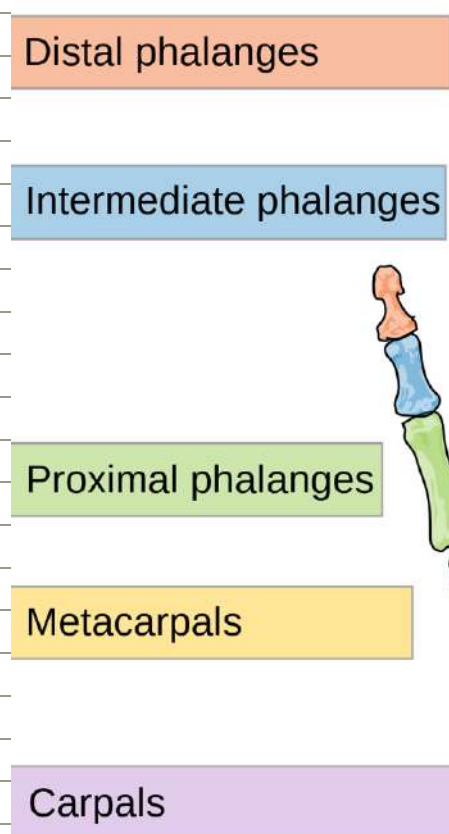
Shoulder girdle formed of two bones =
Clavicle + Scapula

1. **Shoulder (Pectoral) girdle:** Clavicle & Scapula.
2. **Upper arm:** Humerus.
3. **Forearm:** Ulna (medially) & Radius (laterally).
4. **Hand:** Formed of 3 regions (from proximal to distal); Carpus , Metacarpus & phalanges.



⚡ Phalanges in (index,middle,ring & small) fingers:

- Proximal phalanges
- Intermediate phalanges
- Distal phalanges



⚡ Phalanges in thumb

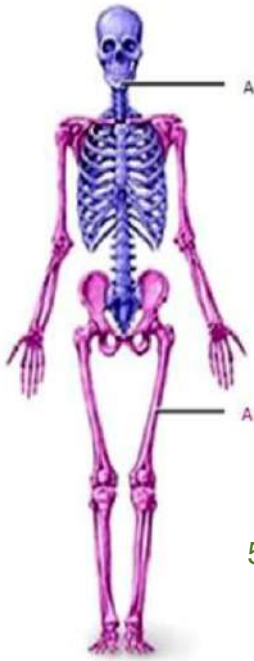
- Proximal phalanges
- Distal phalanges

وال مهم
جاي

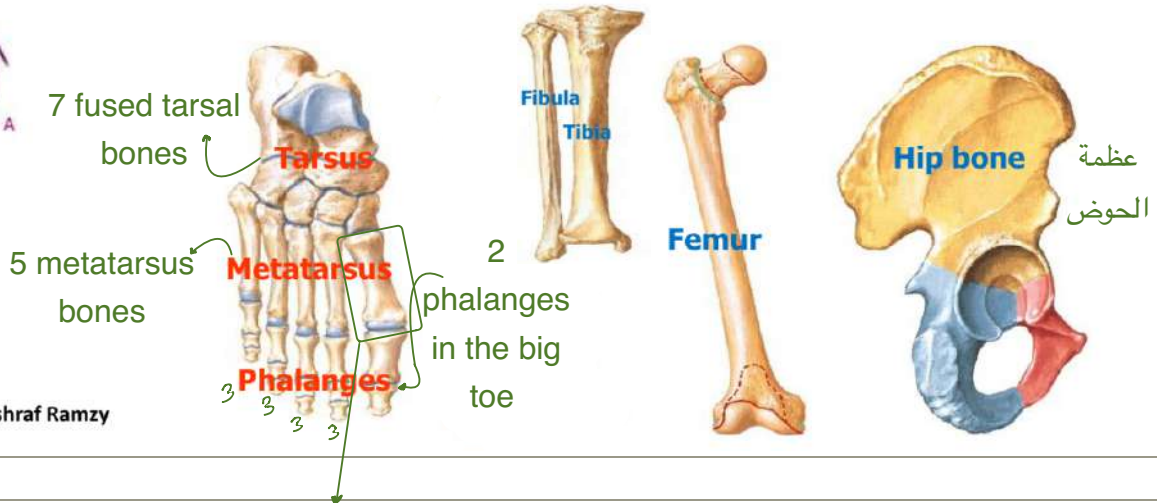
First metacarpal bone is lateral to the rest metacarpal bones

@ Bones of Lower limb:

- 1. Pelvic girdle:** Hip bone. مصنوعة من عظمة وحدة مش زي ال shoulder girdle من 2
- 2. Thigh:** Femur. أطول عظمة في الجسم طولها حوالي 45cm عظمة كبيرة وقوية جداً
- 3. Leg:** Tibia medially & Fibula laterally. بسموها الشظية من كتر ما هي صغيرة
شبه ال Hand
- 4. Foot:** Formed of 3 regions (from proximal to distal); Tarsus, Metatarsus & Phalanges.



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First metatarsus bone is medial to the rest metatarsus bones

	Carpals	Tarsus
SIZE	Smaller to do skill movements	Larger to carry the body weight
NUMBER OF IT'S CONSTITUENT BONES	8	7

COMPARISON

@ Functions of bones:

- 1. Supporting framework of the body.** طول الشخص وحجمه يعتمد الى حد ما على العظام
- 2. Attachment of muscles.** روافع للحركة فانت لما تحمل بايديك اشي العضلة بتقصر والعظمة بتقرب ع العظمة
- 3. Act as Biomechanical levers for movements.** Arm to the forearm
- 4. Protection of underlying organs.** Skull protect brain
Vertebral column protects spinal cord
Thoracic cage protects heart & lungs
- 5. Storehouses for Ca, P & Mg (mineral reservoir).** مخزن ال املاح
- 6. Synthesis of RBCs within the red bone marrow (in ends of long bones, sternum, ribs & vertebrae).** Axial skeleton
- 7. Transmission of body weight.** يتحمل وزن الجسم

Classification of Bones

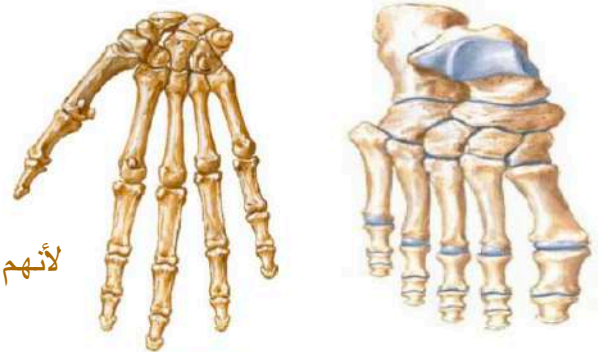
(A) Morphological (Anatomical) classification according to shape of bone:

1. Long bones: have 2 ends & a shaft as bones of proximal & intermediate segments of the limbs (humerus, radius, ulna, femur, tibia & fibula).



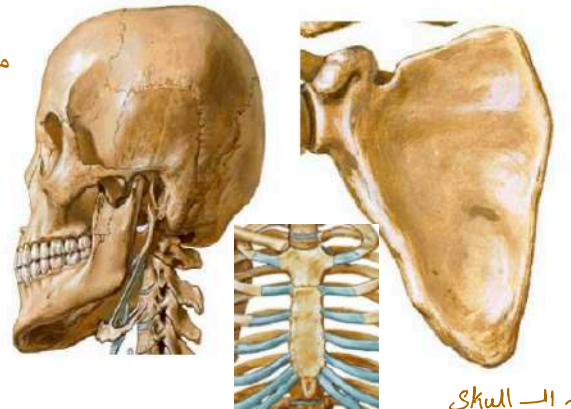
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2. Short bones: as carpal & tarsal bones. These bones are strong & help in limited movements.



لأنهم صغار فحركتهم حركة بسيطة

3. Flat bones: as scapula, sternum & skull cap. These have wide surface for muscle attachment or protection.



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4. Irregular bones: as vertebrae & facial bones.

العظمة نفسها فيها تجويف من 22 Bone

5. Pneumatic bones: contain air-filled spaces lined with mucous membrane (paranasal sinuses) in skull bones (maxilla & frontal bones) to reduce the weight of skull, help in resonance of voice & warm air.



خذ بالك التجويف اللي جوا العظمة نفسها ملوش دعوة بتجويف الجمجمة بتاعت المخ لو كسرتها حتلاقى جوا العظمة نفسها تجويف

Para → بجوار nasal → الأنف sinuses → جيوب

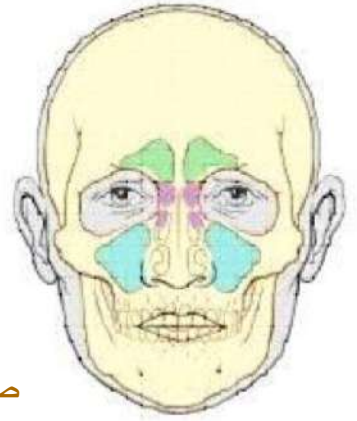
② والدليل وقت الزكام دي الفراغات والجيوب بتتعبى secretions فيطلع الصوت مختق ومش واضح

③ بتدفي هوا اللي داخل للجهاز التنفسي

عُقيدات

6. Sesamoid bone: are small nodules of bone found in the tendons of certain muscles to reduce friction over bony surfaces. e.g. patella & pisiform bones.

توجد في نهاية أي عضلة كبيرة عند الأوتار لمنع الاحتكاك مثل صابونة الركبة patella فلو احتكت العضلة بالعظمة ممكن تتقطع



@ Parts of a growing long bone:

1. 2 ends called **epiphysis** Upper end and lower end of the long bone

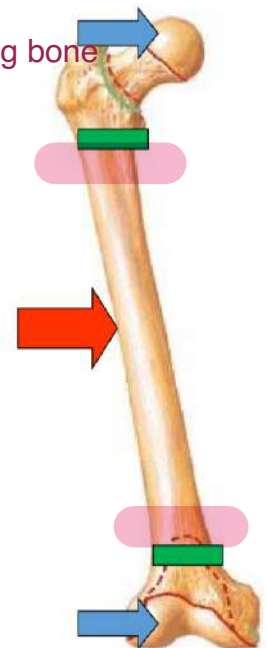
2. A shaft called **diaphysis**.

3. **Epiphyseal plate of cartilage** بين أي end وال shaft

between the diaphysis & epiphysis. This is the most important factor for the growth of bone in length.

4. The part of the shaft close to the plate is called **metaphysis**.

وهي مهمة جداً فهي اللي بتسمح للعظمة بالاستطالة ومع تقدم العمر ال cartilage حتتحول إلى bone وهنا العظمة مش حتتمدد وبوقف طولها



الجنين بكون عبارة عن cartilage ولكن خلال اسبوع الحمل 4-6 ببليش يتحول الى bones من منطقة اسمها

primary centre of ossification (حياة الجنين - قبل ما يتولد -) Intrauterine life

أول ما يتولد بكون عنده ال ends مصنوعة من cartilage وال shaft مصنوعة من bone بعد فترة معينة في نقطة ببليش

من عندها التحول والنقطة هاي موجودة بكل end اللي حبيدا من عندها تحوّل ال cartilage إلى bone حنسميها

secondary centre of ossification

أما ال metaphysis بتفضل cartilage لغاية عمر ال 16-21 تقريبا 1-2 yrs but in females it's earlier

بتصير bone وهون مستحيل الشخص يطول أكثر من هيك ويكون وقف طولها

	The 2 ends	The shaft
1. Name:	epiphysis	diaphysis
2. Develops from:	2ry center of ossification	1ry center of ossification
3. Covered by:	Articular hyaline cartilage بتامت اليناصل	Periosteum
4. Medullary (bone marrow) cavity:	Absent	Present تجويف طوكي
5. Formed of:	Spongy bone	Compact bone

@ **The Periosteum:** غشاء قوي جداً من النسيج الليفي

***This is a fibrous strong membrane which covers the shaft of the bone.

** It consists of an outer fibrous layer & inner (deeper) cellular layer (osteogenic).
كطبقة خارجية قادرة على تكوين العظام

***It has the following functions:

1. Protection of the bone.

2. Provides muscular attachment.

3. Carry blood supply & sensory nerves to the bone.

*4. Has an osteogenic power (bone forming ability) which

plays an important role in the growth of bone in width & the healing of bones after fractures.
لو انكسرت عظمة بكون عظام (بواسطة ال osteogenic)

** Note that the bone grows in length by epiphyseal plate of cartilage & in thickness (breadth) by the periosteum.
عشان العظام اللي تكسرت تتحد

مش قلنا العظام بتطول، هي العظمة حتكبر بالطول (بواسطة ال cartilage epiphyseal) وما بتكبرش بالعرض! طبعاً لازم تكبر، وال periosteum هو المسؤول عن ذلك

+

لو انكسرت عظمة بكون عظام (بواسطة ال osteogenic) عشان العظام اللي تكسرت تتحد



(B) Histological classification according to structure of bone:

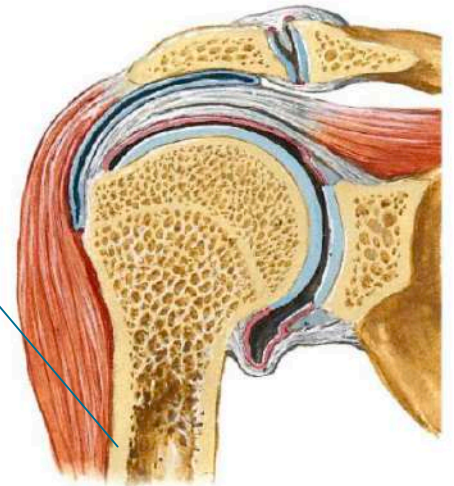
1. Compact (Ivory) bone:

عاجي صلب زي العاج

Outer hard layer in outer surface of shaft of long bones.
منطقة صماء

2. Spongy (Cancellous) bone:

Has pores & consists of irregular trabeculae that form a spongy network such as in sternum.
فيها فراغات فيها نبضات



Where does the bone marrow located?

In the medullary cavity

طيب معنى ده انه ال spongy bone مافيهوش bone marrow !!! لا طبعاً، اكيد فيه بس بالفراغات بتاعت ال bone

صح ال Cancellous bone مافيهوش medullary cavity in the upper bone marrow

ال bone marrow

الأنسجة التي تنمى إلى عظام مصدرها 3 أنواع من الخلايا:

Ectoderm (بيعمل الأنسجة التي بتغطي الجسم للخارج)

Endoderm (بيعمل الأنسجة التي بتبطن الأجهزة الداخلية مثل الجهاز الهضمي، التنفسي، الخ)

Mesoderm (الحشوة بيعمل العضلات والعظام والخ)

(C) Developmental classification according to ossification of bone:

* This means the transformation of the mesodermal tissue into bone. It has 2 types:

1. Intracartilagenous (endochondral) ossification (Cartilagenous bone):

@ In most of long bones, vertebral column & thoracic cage.

@ Early in the intrauterine life (6-8 weeks), a 1ry center of ossification appears in the shaft, where calcification spreads (cartilage model) to help the ossification (bone formation).



شرحناه بالكامل فوق

@ After birth, 2ry centers of ossification appear at the 2 ends of the bone. The shaft & the 2 ends became completely ossified but still separated by a plate of cartilage (epiphyseal plate) to help the growth of bone in length.

@ Finally the bone become ossified at certain age (15-22 years) (in females it is earlier by 1-2 years). This is called **synostosis**.



لما العظام كلها تقفل
بنسبها

2. Intramembranous or mesenchymal ossification

(membranous bone):

Embryonic connective tissue

@ In flat bones (as skull cap or vault of skull & scapula), facial bones & clavicle (except its ends).

* **N.B.:** Clavicle, although, it is a long bone;

✗ Long bone
بس بتتمو على ال membrane

a. It is ossified from a membrane.

b. It has no medullary cavity.

Intrauterine

c. It is first bone to begin ossification (5-6th week of I.U.L.).

life

@ Centre of ossification develops at the mesenchymal tissue then transformed into bone without cartilage formation.

Membrane → bone → cartilage
مبعديش مرحلة ال

Bone marrow

@ It occupies the medullary (marrow) cavity of long bones & the cancellous bones in flat, short & irregular bones.

بالفراغات

@ 2 types: Red type (blood forming or hematopoietic) & Yellow type.

→ RBC Factor

@ With aging, the red marrow ↓ decreases & the yellow marrow ↑ replaces it.

@ In adults, the red marrow is restricted to the bones of the skull, vertebral column, thoracic cage, girdle bones & the head of the humerus & the femur.

→ Axial skeleton

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Arterial blood supply of bone:

1. Periosteal arteries.

2. Metaphyseal & epiphyseal arteries.

3. **Nutrient artery:** A large blood vessel which enters the shaft of the bone near its middle through a nutrient foramen. It enters the bone perpendicular to the surface. As the bone elongates unequally from both ends, the artery becomes deflected away from the growing end.

*** The final direction of the nutrient artery of a limb bone is summarized by the following rule (to the elbow I go, from the knee I flee).

*** The growing end of the bone is opposite the direction of the nutrient artery.



قراءة ذاتية للاستزادة بالعلم

Takes nutrients from surrounding fluid

لا وعائى يعني مفيش artery بروح يغذيها

B. Cartilages

Chondro = cartilage

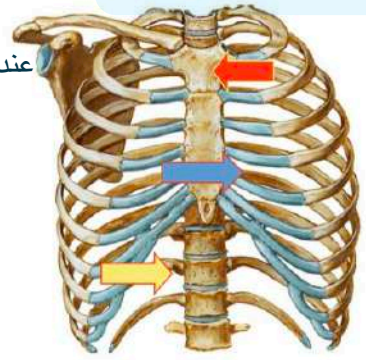
@ **Avascular** dense flexible connective tissue.

@ It is formed of **chondrocytes (cartilage cells) & gel-like matrix** which is responsible for its firmness & resilience). المرونة والصلابة

@ **Perichondrium** is a fibrous membrane that covers the cartilage.

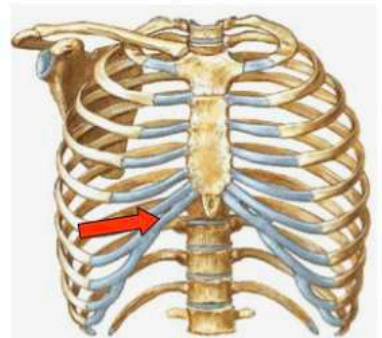
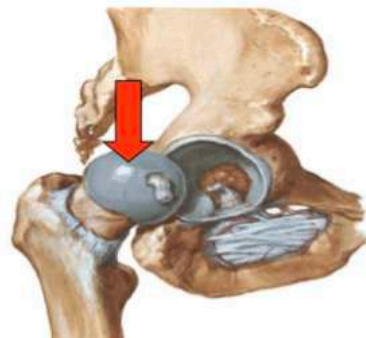
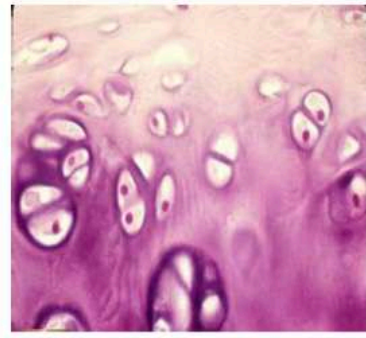
@ According to nature of the matrix, there are 3 types of cartilages.

عندنا 3 أنواع للوسط اللي بتسبح فيه الخلايا:



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1. Hyaline cartilage



@ Has a high content of homogenous & transparent matrix.

@ Sites: **1. Foetal bones.**

2. Articular cartilages of synovial joints.

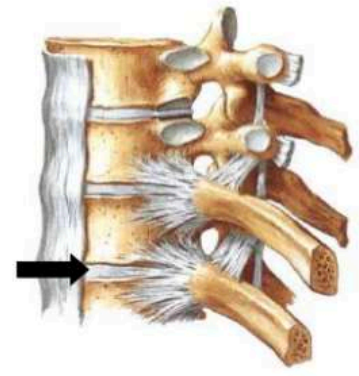
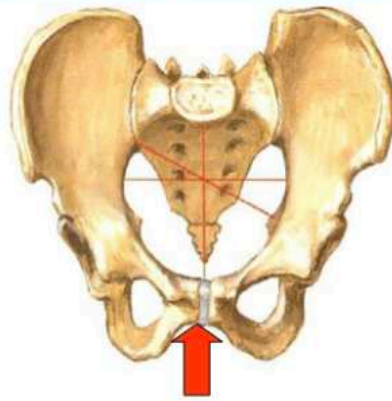
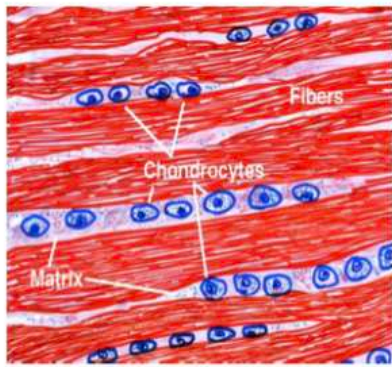
3. Costal cartilages of ribs.

4. Epiphyseal plates of long bones.

5. Cartilages of respiratory passages eg. Trachea.

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2. White fibrocartilage



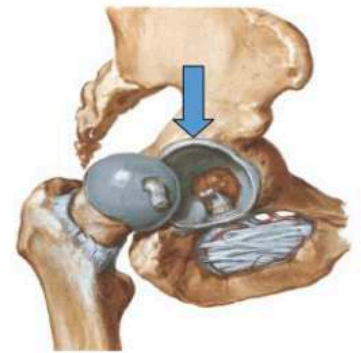
@ The matrix is little & rich in collagenous bundles which add strength & durability to this cartilage.

@ **Sites:** التي عند الحوض

1. Symphysis pubis & Intervertebral discs.
2. Labrum of some synovial joints (Hip & Shoulder).
3. Discs within joints (temporo-mandibular, sterno-clavicular & knee joints).

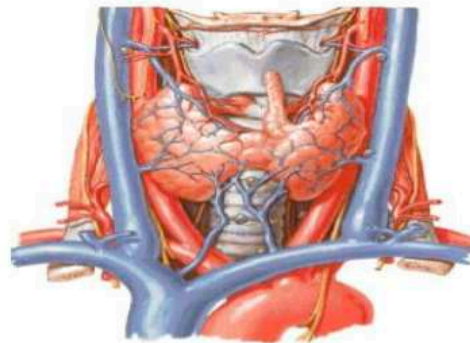
المفصل اللي بتستعمله لما تفتح فمك

Dr Ashraf Ramzy



The strongest type of cartilage white fibrocartilage

3. Yellow elastic cartilage



@ The matrix is rich in elastic fibers which provide flexibility to this form of cartilage.

@ **Sites:** Auricle of ear, Tip of nose & epiglottis.

أرنبة الأنف

لسان المزمار
في بداية
ال Trachea



The most flexible type of cartilage yellow elastic cartilage

Types of cartilage



Hyaline cartilage



White fibrocartilage



Yellow elastic cartilage

Functions of cartilage

1. It helps in maintaining patency of the respiratory passages.
2. It shares in the formation of the skeleton of the body.
3. It forms smooth firm articular surface of joints.

تابت و فاصل

Dr Ashraf Ramzy

THANK
YOU