Introduction to the Human Body

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Definitions

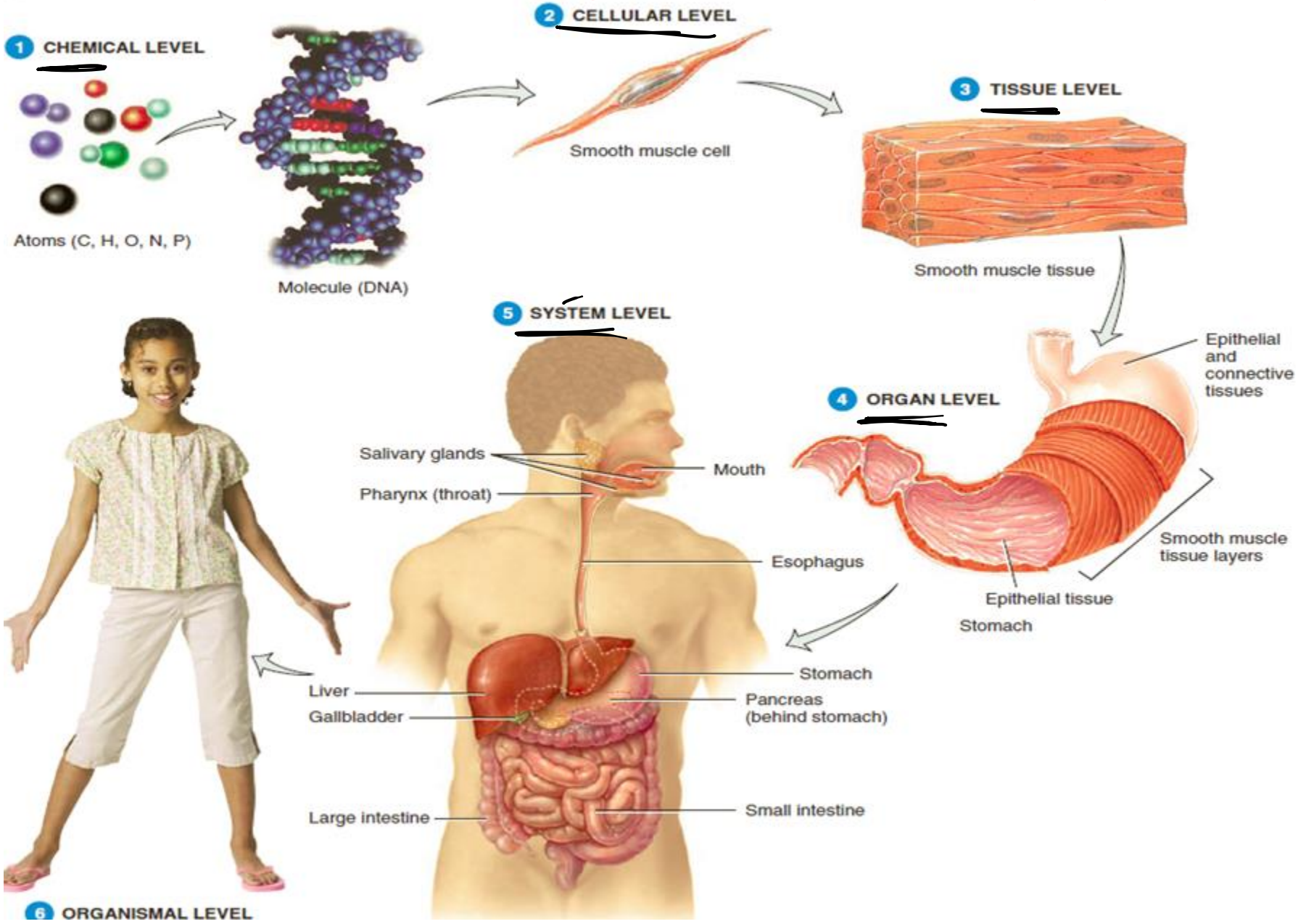
Anatomy:

- Is the science of body structures and the relationships among them.
- First studied by Dissection, the careful cutting apart of body structures to study their relationship.

Physiology:

- The science of body functions
- How the parts work together.

Levels of Structural Organization and Body Systems



Levels of Structural Organization and Body Systems

A. CHEMICAL LEVEL

Basic level

1. Atoms are the smallest unit of matter

- Essential atoms for life include carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), calcium (Ca), and sulfur (S)

2. Molecules two or more atoms joined together

- Deoxyribonucleic acid (DNA)
- Glucose

Levels of Structural Organization and Body Systems

B. CELLULAR LEVEL

- Molecules combine to form cells

- **Cells** are the basic structural and functional units of an organism

- Many kinds of cells in the body:

✓ Muscle cells

✓ Nerve cells

✓ Epithelial cells, etc.

• العديد من أنواع الخلايا في الجسم:

✓ خلايا العضلات

✓ الخلايا العصبية

✓ الخلايا الظهارية، إلخ.

Levels of Structural Organization and Body Systems

C. TISSUE LEVEL

- **Tissues** are groups of cells and materials surrounding them

Four basic types of tissues:

1. Epithelial
2. Connective
3. Muscular
4. Nervous

أربعة أنواع أساسية من الأنسجة:

1. ظهاري
2. متصل
3. عضلي
4. عصبي

Levels of Structural Organization and Body Systems

D. ORGAN LEVEL

- Tissues are joined together to form **organs**
- **Organs** are structures that are composed of two or more different types of tissues
- Specific functions and recognizable shapes

Examples:

1. Heart
2. Lungs
3. kidneys
4. Stomach, etc.

Levels of Structural Organization and Body Systems

E. SYSTEM LEVEL

- A system consists of related organs with a common function

الجهاز الهضمي ينهار ويمتص الطعام

❖ يتضمن أعضاء مثل الفم، الصغيرة والكبيرة

الأمعاء والكبد والمرارة والبنكرياس

• أحد عشر نظاما لجسم الإنسان

Example:

❖ Digestive system breaks down and absorbs food

❖ It include s organs such as the mouth, small and large intestines, liver, gallbladder, and pancreas

- Eleven systems of the human body

11

Levels of Structural Organization and Body Systems

F. ORGANISM LEVEL

- An organism or any living individual
- All parts of the body
- Functioning together

Organ systems

1. Integumentary جلدي
2. Skeletal عظمي
3. Muscular عضلي
4. Nervous عصبي
5. Endocrine الغدد الصماء
6. Cardiovascular القلب و الأوعية الدموية
7. Lymphatic/immune ليمفي
8. Respiratory تنفسي
9. Digestive هضمي
10. Urinary بولي
11. Reproductive تناسلي

Characteristics of the Living Human Organism

Basic Life Processes

- Distinguish living from non-living things

Six important life process

1. Metabolism
2. Responsiveness
3. Movement
4. Growth
5. Differentiation
6. Reproduction

Metabolism

Metabolism

- Sum of all the chemical process that occur in the body

هدم

- **Catabolism** or the break down of complex chemical substances into simpler components

بناء

- **Anabolism** or the building up of complex chemical substances from smaller, simpler components

Responsiveness

الاستجابة

Responsiveness

قدرة الجسم على الكشف والاستجابة لها

- Ability of the body to detect and respond to changes

تغييرات

Examples:

- Decrease in body temperature
- Responding to sound
- Nerve (electrical signals) and muscle cells (contracting)

Movement and Growth

Movement

- Motion of the whole body
- Organs, cells, and tiny subcellular structures
- Leg muscles move the body from one place to another

Growth

- Increase in body size, due to an increase in existing cells, number of cells, or both

Differentiation

Differentiation

- Development of a cell from an unspecialized to specialized state
- Cells have specialized structures and functions that differ from precursor cells
- **Stem cells** give rise to cells that undergo differentiation

Reproduction

- Formation of new cells (growth, repair, or replacement)

- Production of a new individual

التوازن Homeostasis

- A condition of **equilibrium** (balance) in the body's internal environment
- Dynamic condition
- Narrow range is compatible with maintaining life

Example

- ❑ Blood glucose levels range between 70 and 110 mg of glucose/dL of blood
- ❑ Whole body contributes to maintain the internal environment within normal limits

Homeostasis and Body Fluids

- Maintaining the volume and composition of body fluids are important

- **Body fluids** are defined as dilute, watery solutions containing dissolved chemicals inside or outside of the cell

1. Intracellular Fluid (ICF)

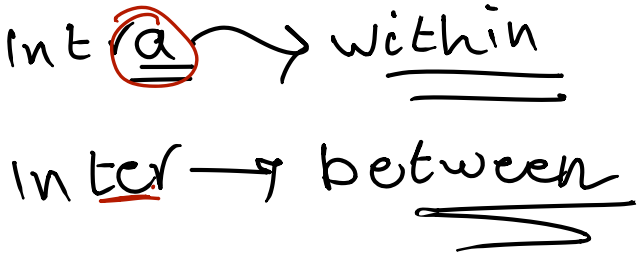
- Fluid within cells

2. Extracellular Fluid (ECF)

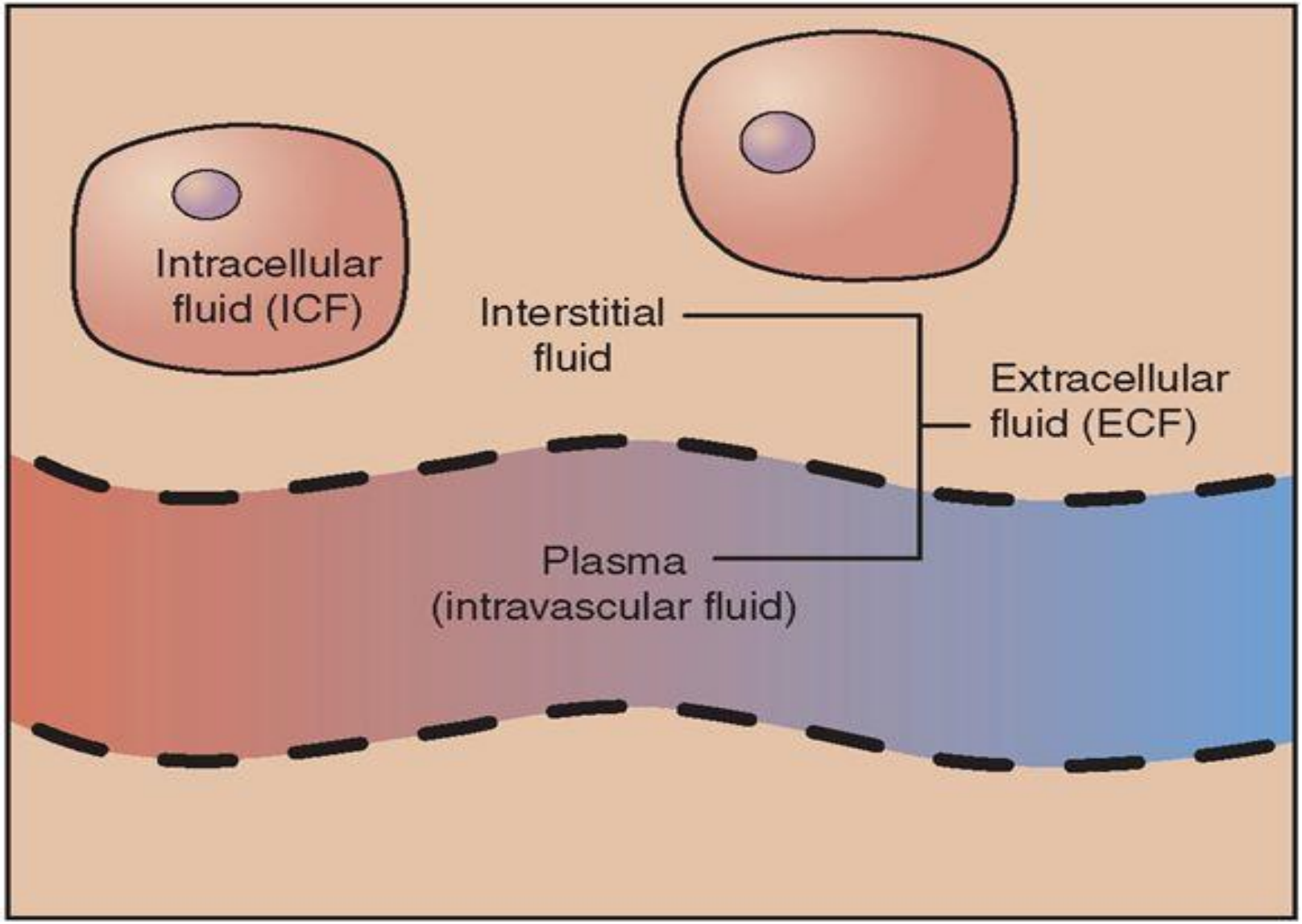
- Fluid outside cells

3. Interstitial fluid (ECF)

- Fluid between cells and tissues



Homeostasis and Body Fluids



ECF and Body Location

1. Blood Plasma

- ECF within blood vessels

2. Lymph

- ECF within lymphatic vessels

3. Cerebrospinal fluid (CSF)

- ECF in the brain and spinal cord

4. Synovial fluid

- ECF in joints

5. Aqueous humor and vitreous body

- ECF in eyes

السائل الخلالي ووظيفة الجسم

Interstitial Fluid and Body Function

تعتمد الوظيفة الخلوية على تنظيم

تكوين السائل الخلالي

- Cellular function depends on the regulation of composition of interstitial fluid

• تكوين تغيرات السوائل الخلالية أثناء تحركها

• الحركة ذهابا وإيابا عبر الجدران الشعرية

توفير العناصر الغذائية (الجلوكوز والأكسجين والأيونات) للأنسجة

- Composition of interstitial fluid changes as it moves

الخلايا وتزيل النفايات (ثاني أكسيد الكربون)

- Movement back and forth across capillary walls provide nutrients (glucose, oxygen, ions) to tissue cells and removes waste (carbon dioxide)

Chapter two.

Chapter 2

Introduction to the Human Body II

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الجلد

Integumentary System

Components: Skin and associated: hair, nails, sweat glands, and oil glands.

غدد عرقية

غدد الدهنية

Functions:

1. Protects body
2. helps regulate body temperature
3. eliminates some waste
4. makes Vitamin D
5. Sensation
6. stores fat.

1. يحمي الجسم
2. يساعد على تنظيم الجسم درجة الحرارة
3. يزيل بعض النفايات
4. يجعل فيتامين د
5. إحساس
6. يخزن الدهون.

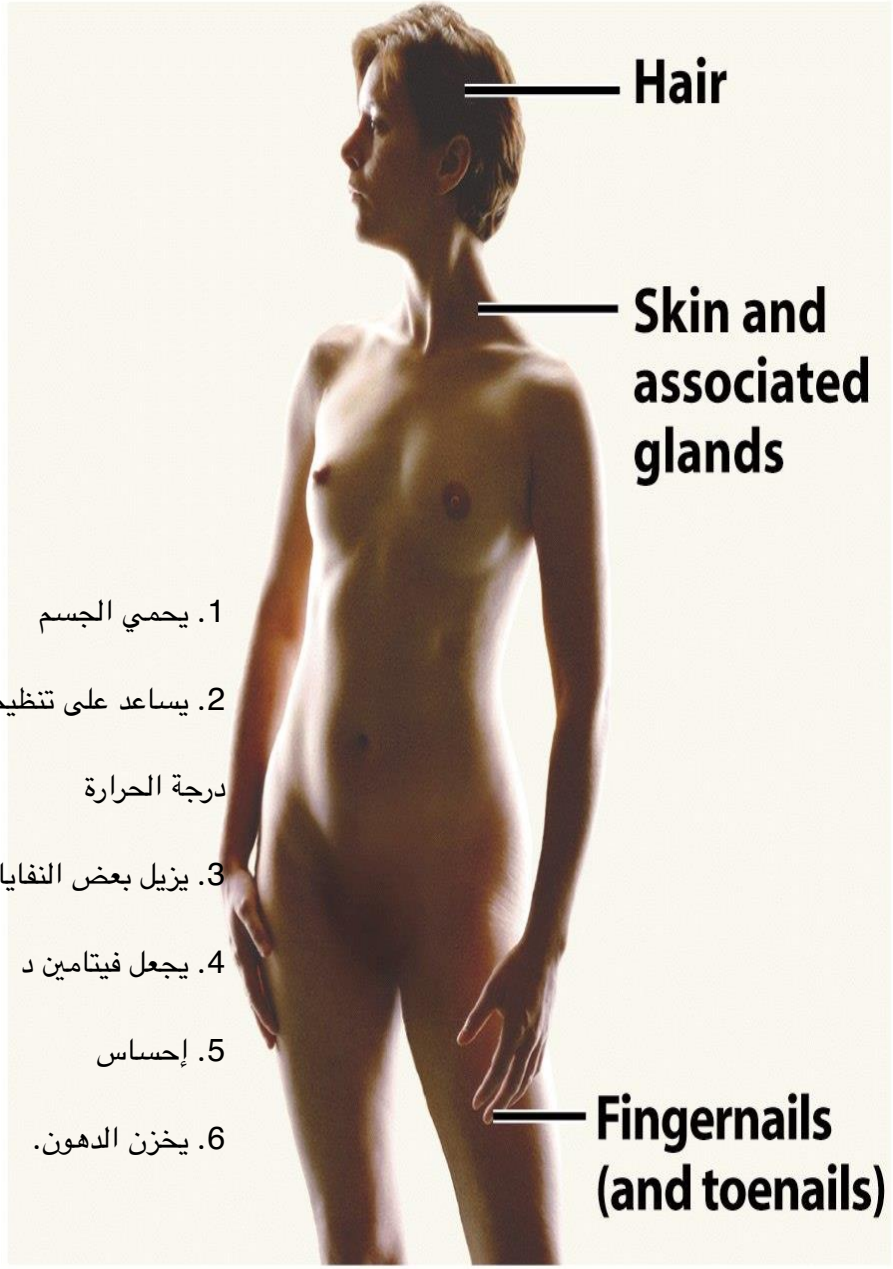


Table 1-2 figure 1 Principles of Anatomy and Physiology, 11/e

Skeletal System

Components: Bones and joints and associated cartilages.

Functions:

1. Supports and protects body
2. provides surface area for muscle attachment
3. aids body movement
4. houses cells that produce blood cells
5. stores minerals

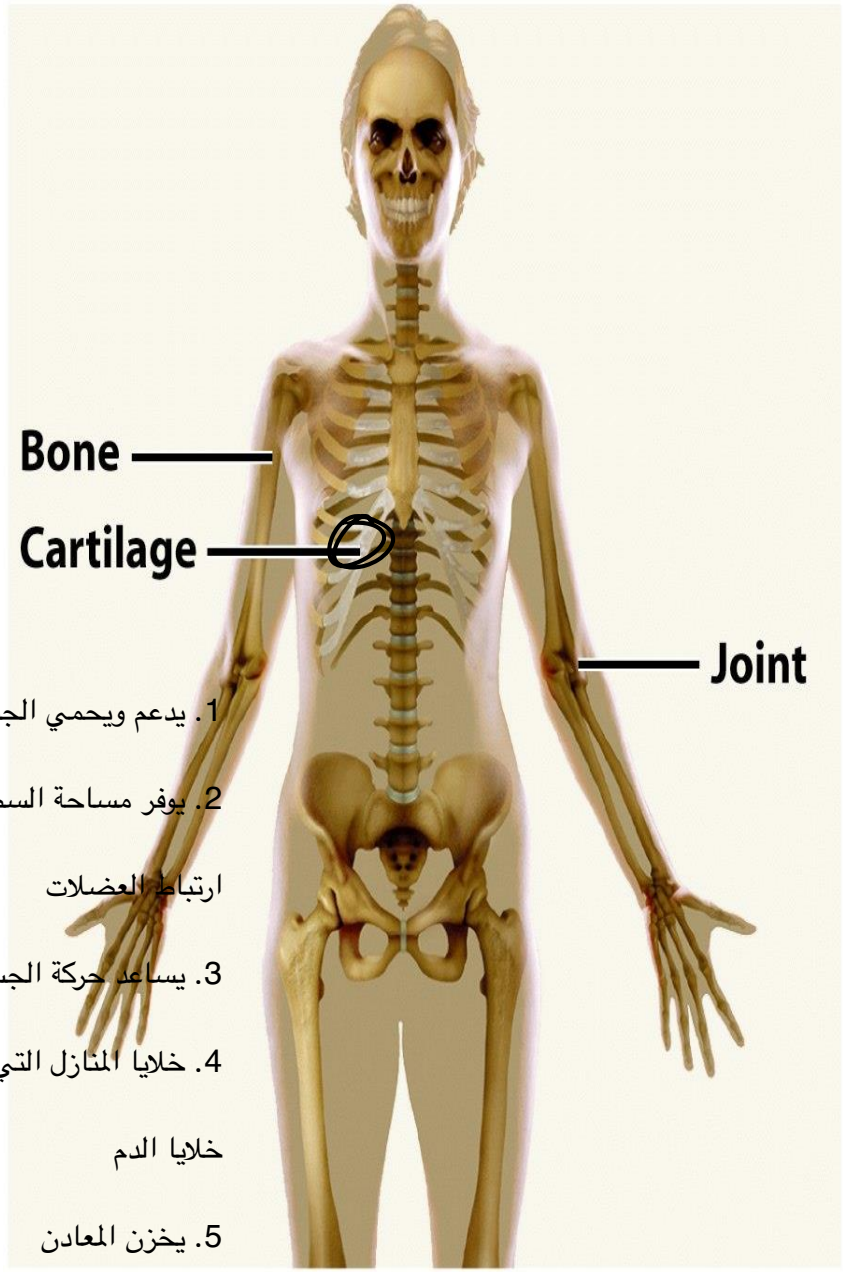


Table 1-2 figure 2 Principles of Anatomy and Physiology, 11/e

عضلي

Muscular System

Components: Skeletal muscle tissues (muscles attached to bones)

Functions:

1. Body movements
2. posture → شكل الجسم
3. heat production.

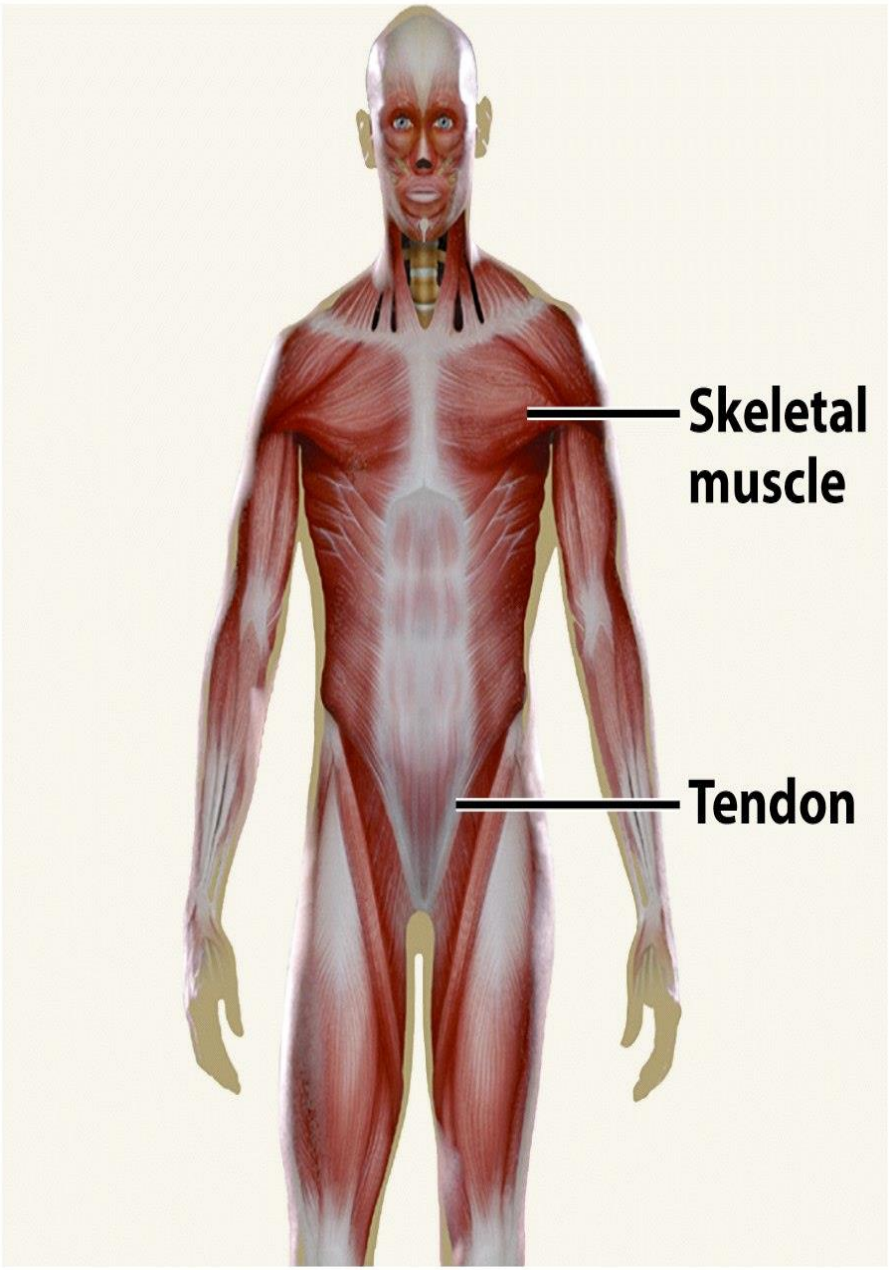


Table 1-2 figure 3 Principles of Anatomy and Physiology, 11/e

* الاستجابة سريعة وقصيرة

Nervous System

Components: Brain, spinal cord, nerves and sense organs such as eyes and ears.

Functions:

1. Generates action potentials (nerve impulses) to regulate body activities
2. internal and external environmental detection
3. interprets changes
4. responds by muscular contractions or glandular secretions.

1. يولد إمكانات العمل (النبضات العصبية) لتنظيم أنشطة الجسم
2. داخلي وخارجي الكشف عن البيئة
3. يفسر التغييرات
4. يستجيب عن طريق العضلات الانقباضات أو الغدة إفرازات

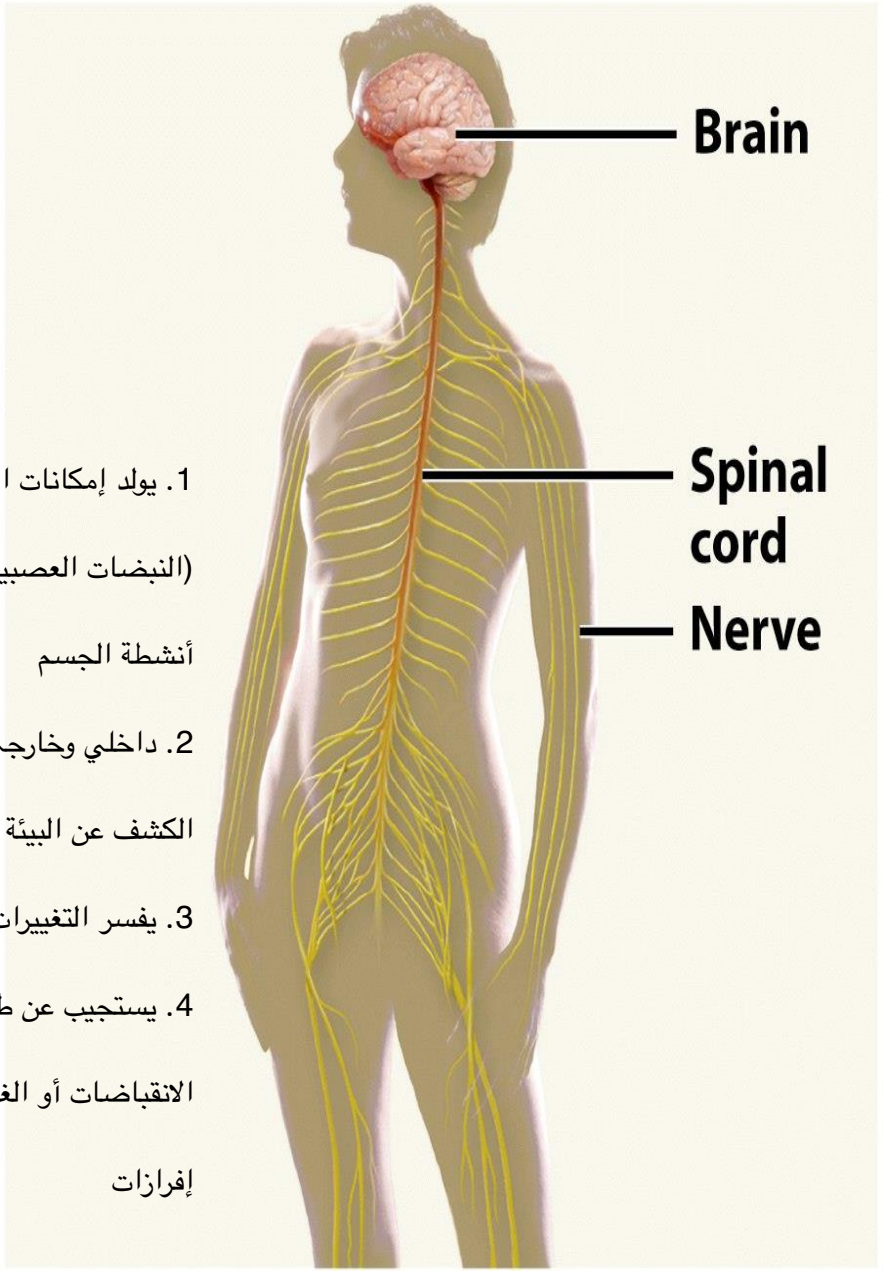


Table 1-2 figure 4 Principles of Anatomy and Physiology, 11/e

Endocrine System

Components:

Hormone producing glands (pineal gland, hypothalamus, pituitary gland, thymus, thyroid gland, parathyroid glands, adrenal glands, pancreas, ovaries, and testes).

Functions:

- Regulates body activities by releasing hormones (chemical messengers transported in blood from endocrine gland to tissue or target organ)

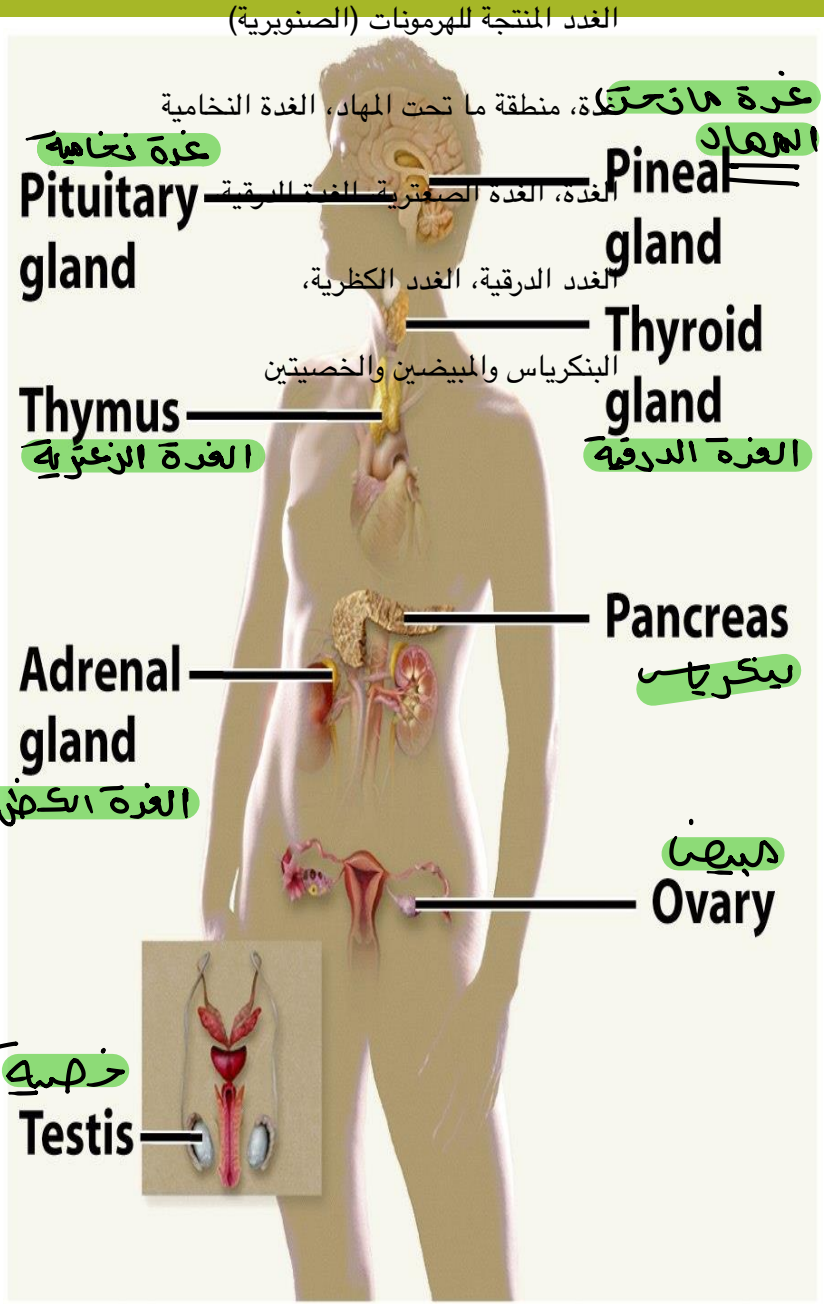


Table 1-2 figure 5 Principles of Anatomy and Physiology, 11/e

Cardiovascular System

القلب والأوعية الدموية

Components:

Blood, heart, blood vessels

دم قلب أوعية دموية

Functions:

1. Heart pumps blood through the blood vessels
2. blood carries O2 and nutrients to cells and CO2 waste away from cells and helps regulate acid-base balance, temperature, and water content of body fluids
3. components of blood helps fight against disease and repair blood vessels

1. يضخ القلب الدم من خلال الأوعية الدموية
2. يحمل الدم O2 والمواد المغذية إلى الخلايا ونفايات ثاني أكسيد الكربون بعيداً عن الخلايا وتساعد على تنظيم الحمض القاعدي التوازن ودرجة الحرارة والماء محتوى سوائل الجسم
3. مكونات الدم تساعد على القتال ضد المرض وإصلاح الدم سفن

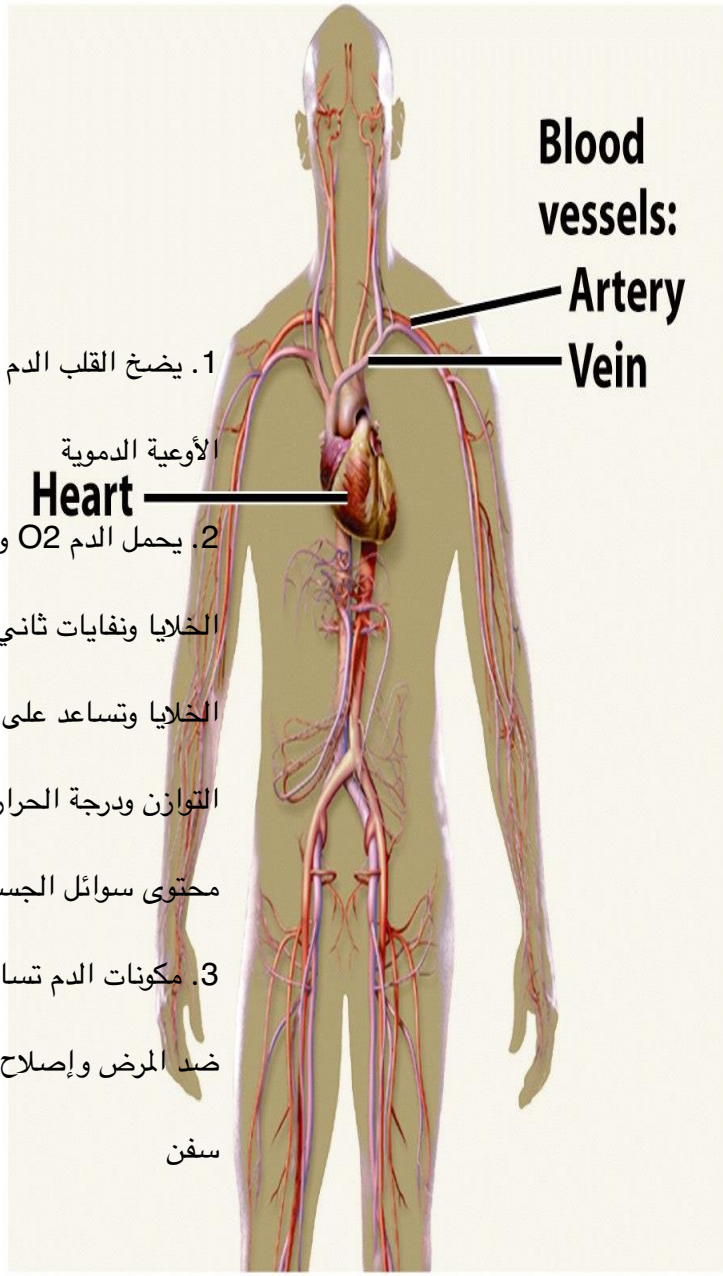


Table 1-2 figure 6 Principles of Anatomy and Physiology, 11/e

Lymphatic System and Immunity

Components:

Lymphatic fluid and vessels; spleen, thymus, lymph nodes, and tonsils. Cells that carry out immune responses (B Cells, T Cells, etc.)

Functions:

1. Returns proteins and fluids to blood
2. carries lipids from gastrointestinal tract to blood,
3. contains sites of maturation and proliferation of B Cells and T Cells that protects against disease-causing microbes.

1. يعيد البروتينات والسوائل إلى دم

2. يحمل الدهون من الجهاز الهضمي المسالك إلى الدم،

3. يحتوي على مواقع النضج و انتشار الخلايا البائية وT الخلايا التي تحمي من الأمراض- تسبب الميكروبات

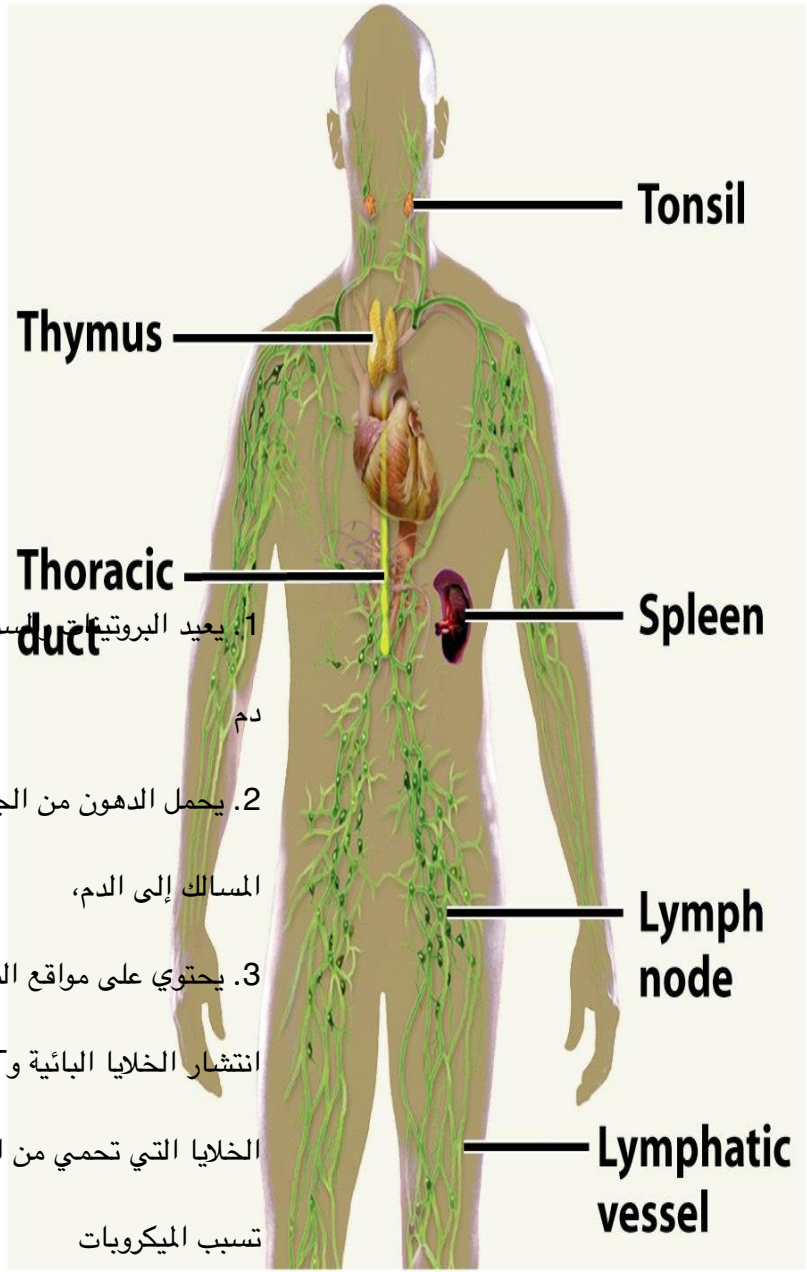


Table 1-2 figure 7 Principles of Anatomy and Physiology, 11/e

Respiratory System التنفسي

Components:

Lungs, Pharynx (throat), larynx (voice box), trachea (wind pipe), bronchial tubes

Functions:

1. transfers O2 into blood and CO2 out of blood.
2. Regulates acid-base balance of body fluids,
3. air flowing out of lungs through vocal cords produces sounds.

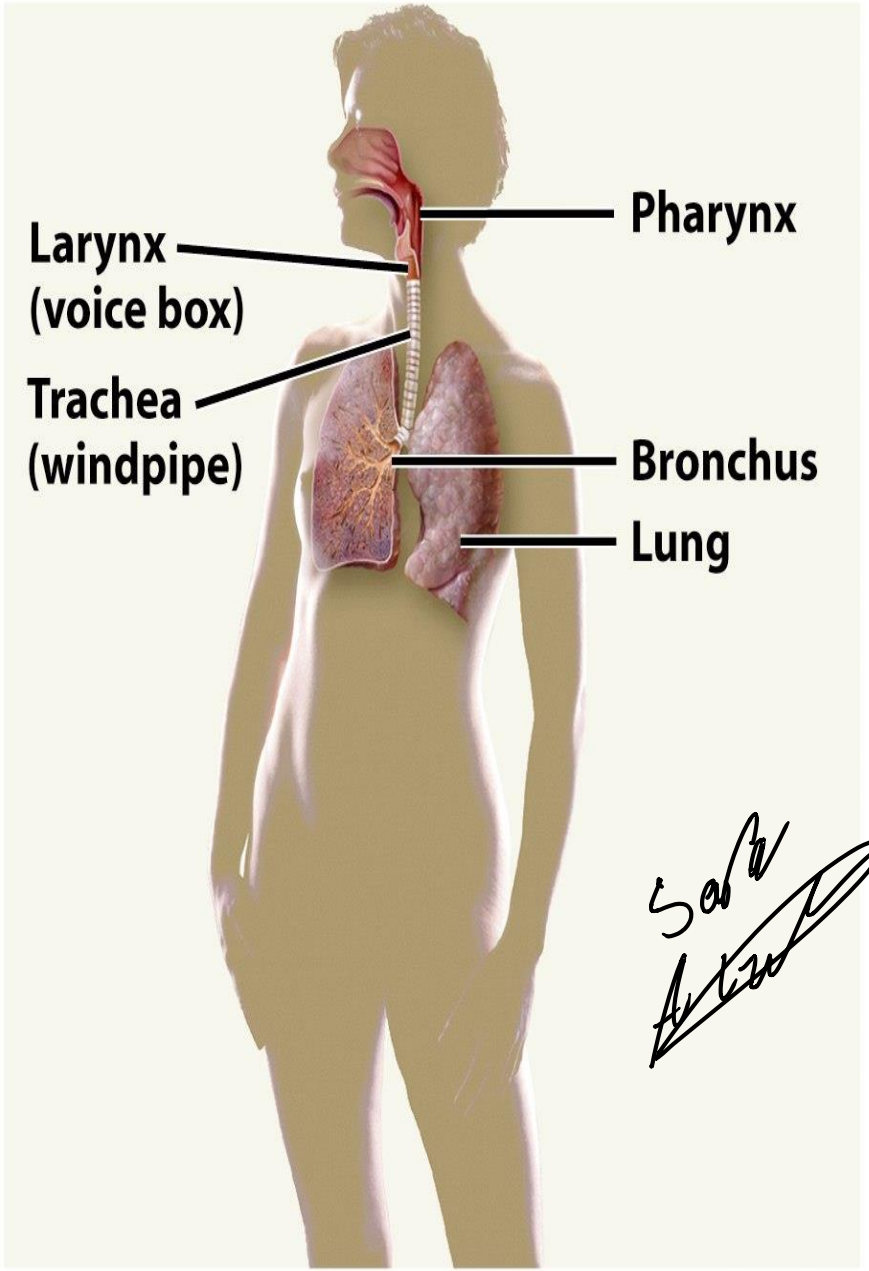


Table 1-2 figure 8 Principles of Anatomy and Physiology, 11/e

Digestive System

Sara.Zatari

Components:

- gastrointestinal tract which includes: mouth, pharynx, esophagus, stomach, small and large intestines, anus.
- Accessory organs that assist in digestion: salivary glands, liver, gallbladder, pancreas.

Functions:

1. physical & chemical breakdown of food
2. absorbs nutrients
3. eliminates solid wastes.

1. الانهيار الفيزيائي والكيميائي من الطعام
2. يمتص العناصر الغذائية
3. يزيل النفايات الصلبة

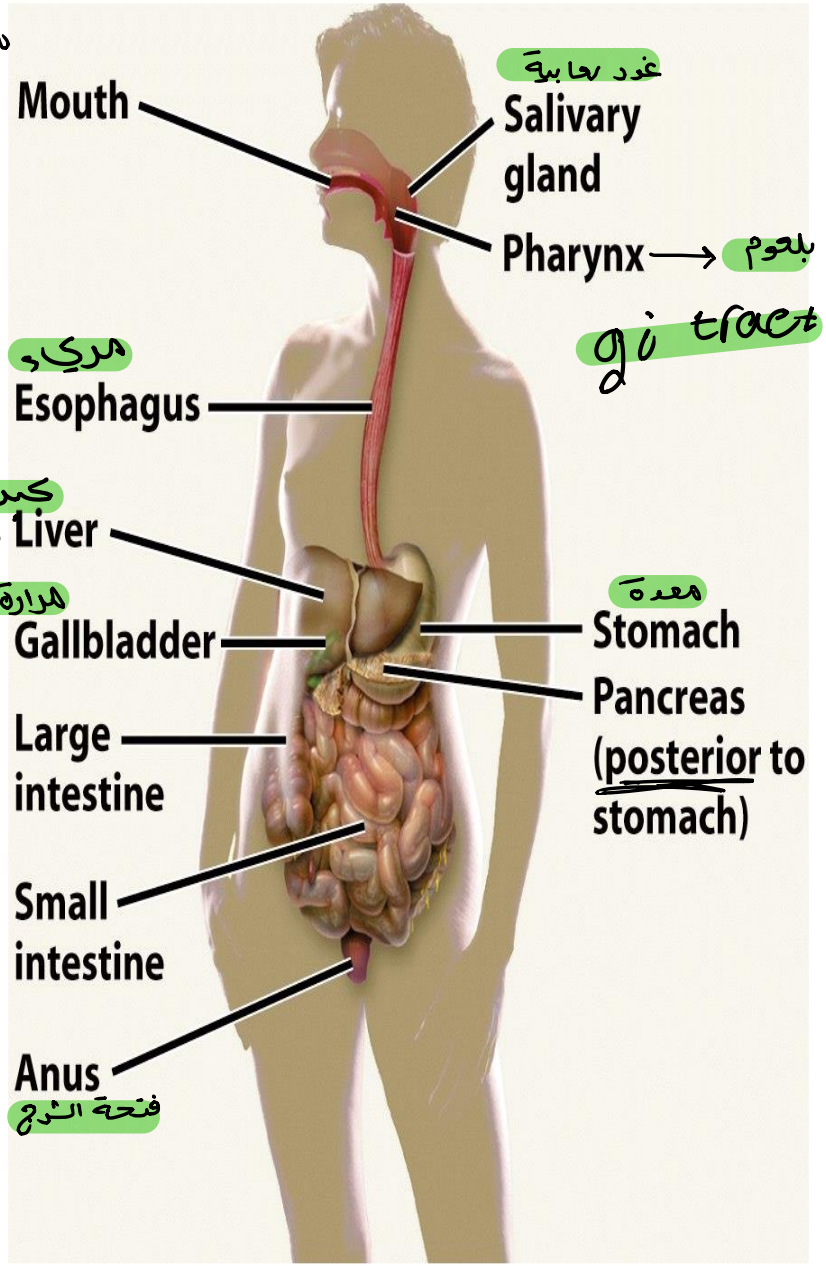


Table 1-2 figure 9 Principles of Anatomy and Physiology, 11/e

Urinary System

Components:

Kidneys, ureters, urinary bladder, urethra.

Functions:

1. Produces, stores, and eliminates urine
2. eliminates wastes and regulates volume and chemical composition of blood
3. acid-base balance
4. maintains mineral balance
5. regulate production of red blood cells.

1. ينتج ويخزن و
يزيل البول
2. يزيل النفايات و
ينظم الحجم والمواد الكيميائية
تكوين الدم
3. التوازن الحمضي القاعدي
4. يحافظ على التوازن المعدني
5. تنظيم إنتاج اللون الأحمر
خلايا الدم.

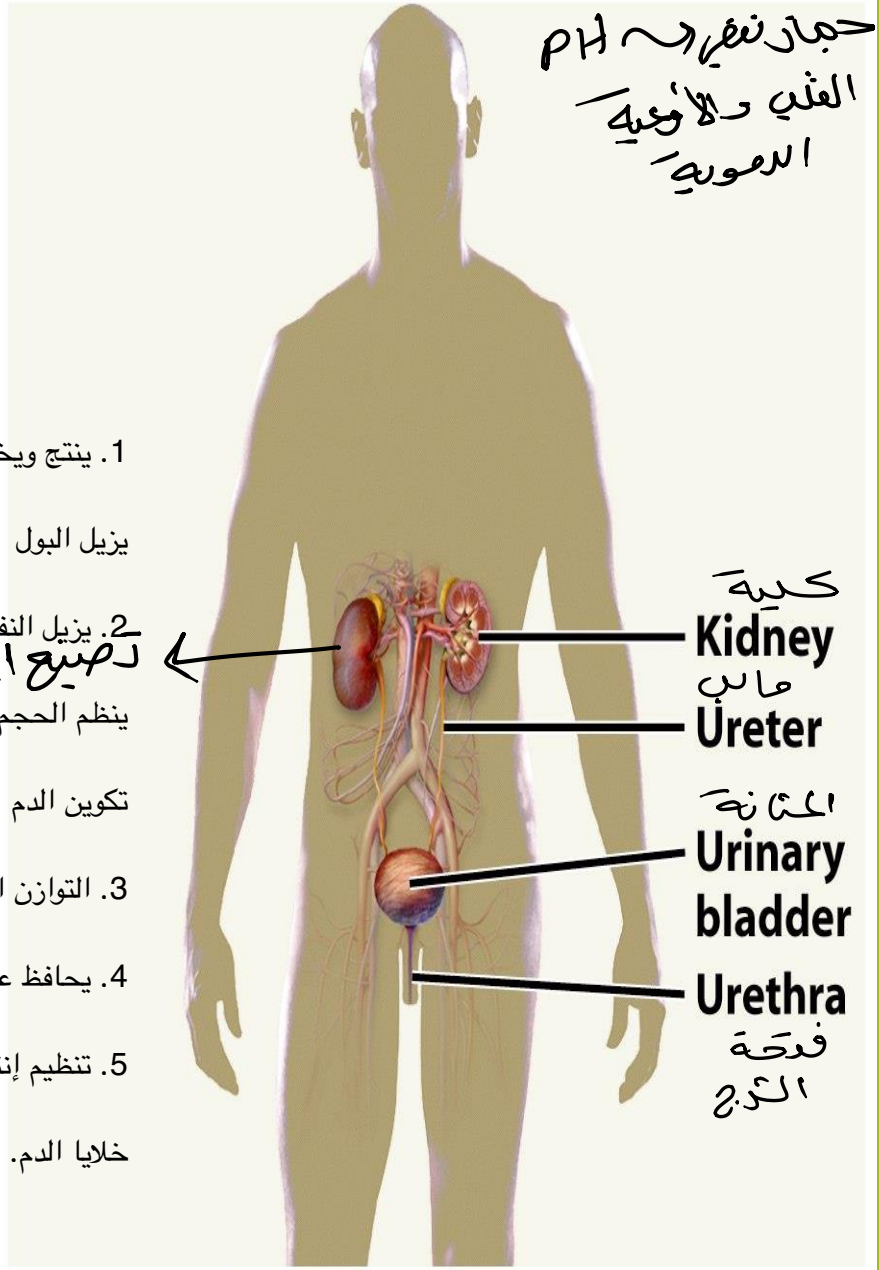


Table 1-2 figure 10 Principles of Anatomy and Physiology, 11/e

تناسلي Reproductive System

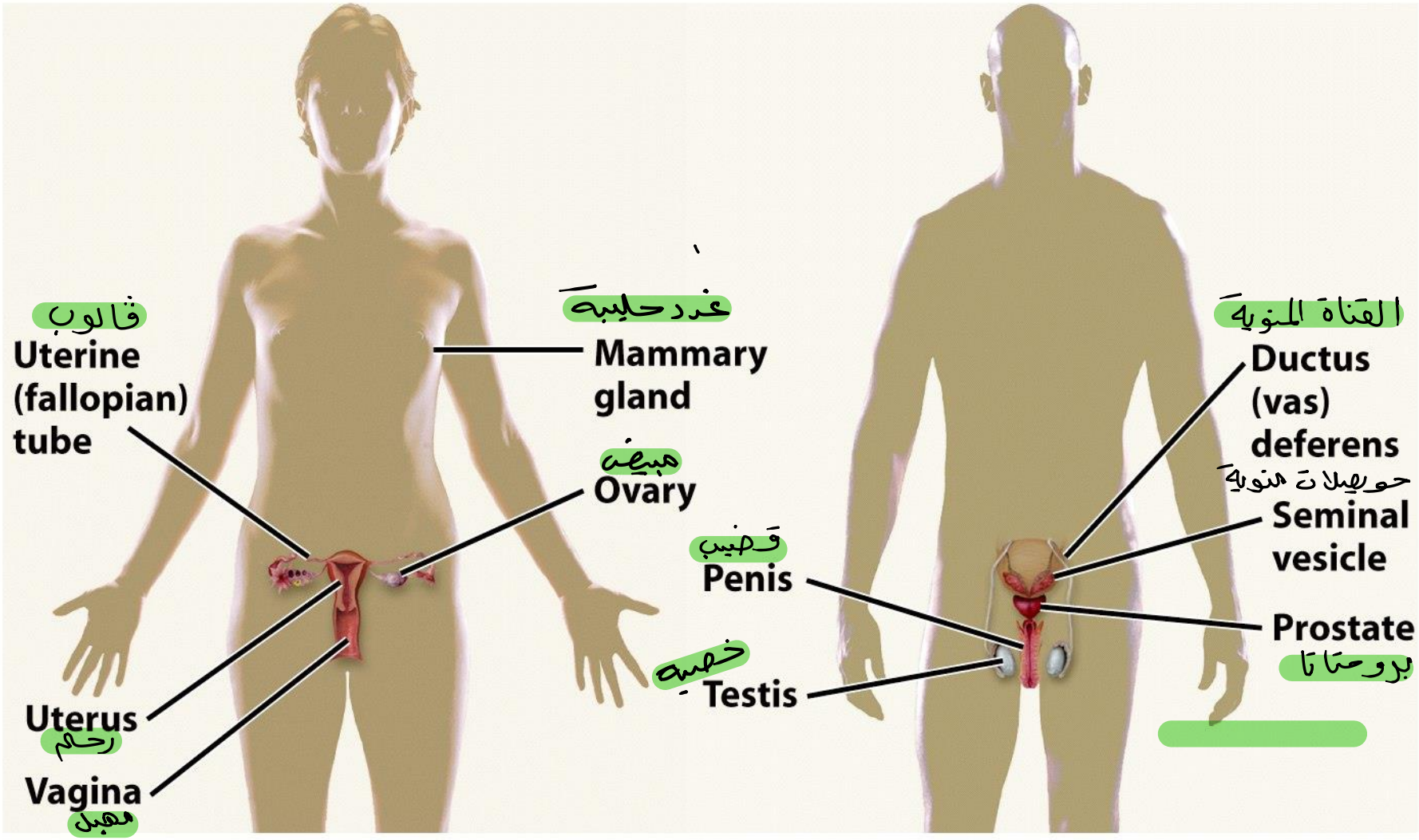


Table 1-2 figure 11 Principles of Anatomy and Physiology, 11/e

Reproductive System

Components:

Gonads (Ovaries or Testes) and associated organs

Females:

(قناتي الرحم، قناتي فالوب، الرحم، المهبل، الغدد الثديية

(uterine tubes, fallopian tubes, uterus, vagina, mammary glands

Males:

البربخ، القناة/القناة المنوية، الحويصلات المنوية، البروستاتا، القضيب

epididymis, ductus/vas deferens, seminal vesicles, prostate, penis

Functions:

1. Gonads produce gametes (sperm or oocytes) that combine to produce new organism
2. gonads release hormones that regulate reproduction and other body processes
3. transport and store gametes; mammary glands produce milk.

1. تنتج الغدد التناسلية الأمشاج (الحيوانات المنوية أو البويضات) التي تتحد مع إنتاج كائن حي جديد
2. الغدد التناسلية تطلق الهرمونات التي تنظم التكاثر وغيرها عمليات الجسم
3. نقل وتخزين الأمشاج؛ تنتج الغدد الثديية الحليب.

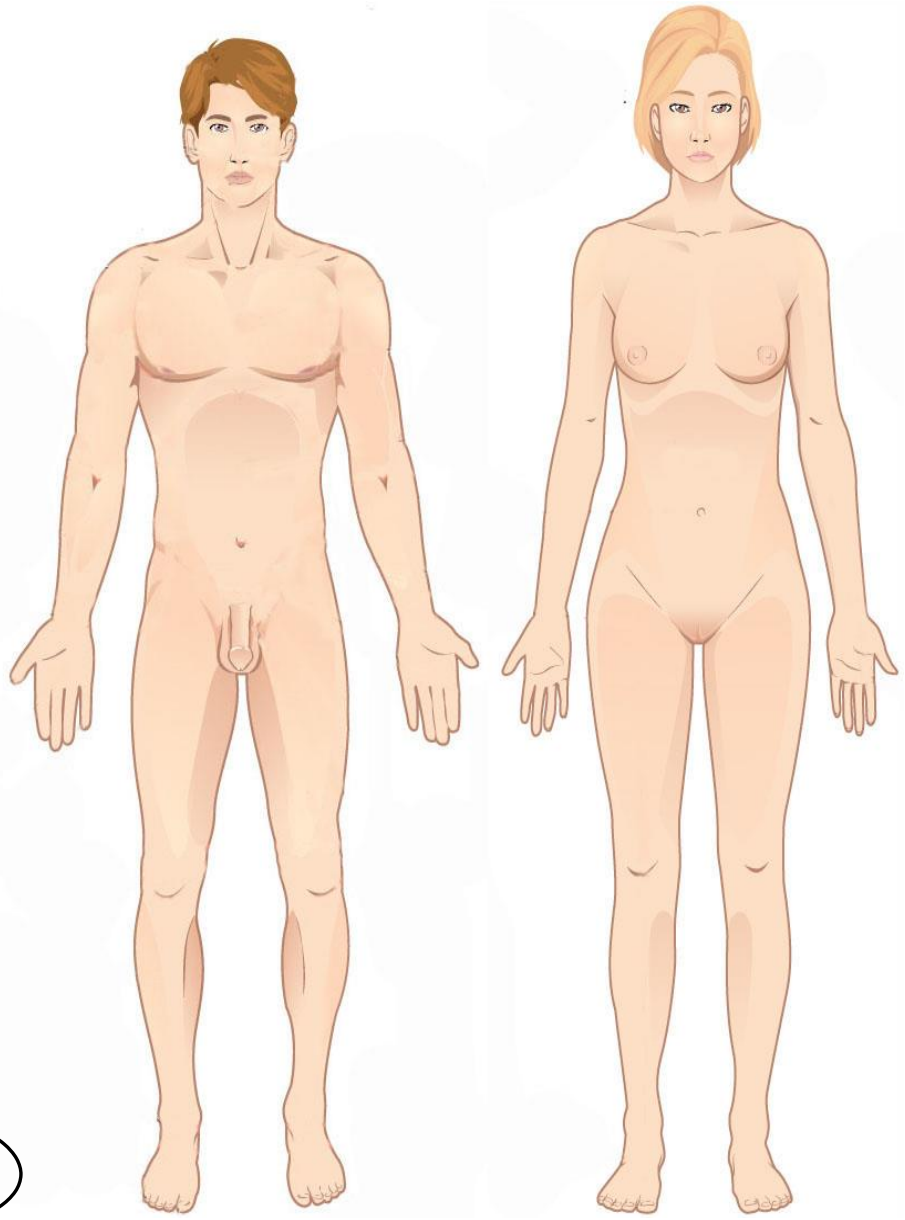
مالالاوضح

Basic Anatomical Terminology

Body Positions

Anatomical Position:

1. the position is standing
2. facing forward
3. limbs on the side
4. palms facing forward



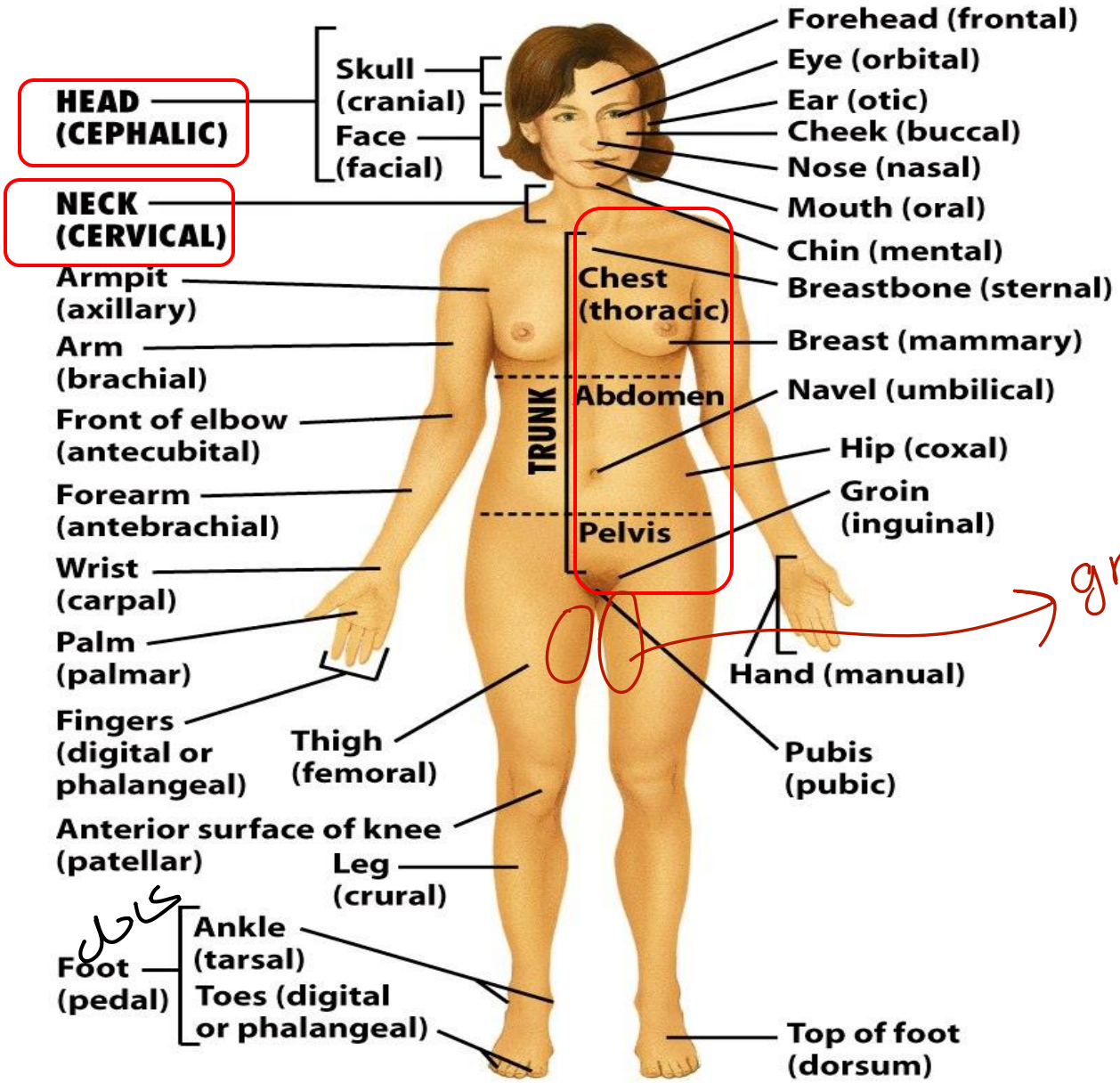
على البطن

- **Prone:** describes a body lying facedown
- **Supine:** lying face up

على الظهر

Regional Names

- **Head:** consists of the skull and face.
- **The skull:** encloses and protects the brain
- **The face:** is the front portion of the head.
- **Neck:** supports the head and attaches it to the trunk.
- **Trunk:** Consists of the chest, abdomen, and pelvis.
- **Upper Limb:** attaches to the trunk and consists of shoulder, armpit, arm, forearm, wrist, and hand.
- **Lower Limb:** attaches to the trunk and consists of the buttock, thigh, leg, ankle, and foot.
- **Groin:** area on the front surface marked by a crease on each side



Anterior view

Figure 1-5a Principles of Anatomy and Physiology, 11/e

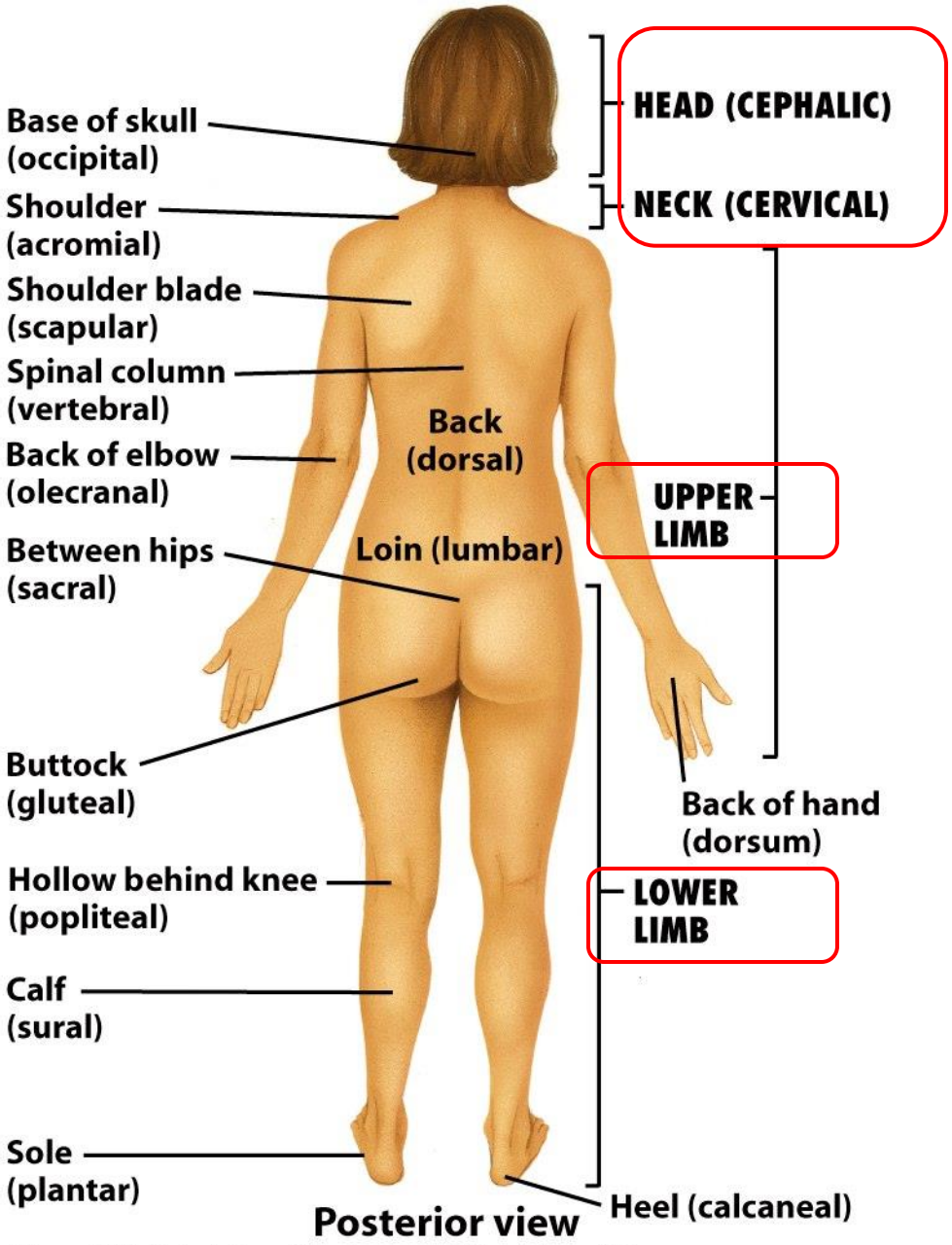


Figure 1-5b Principles of Anatomy and Physiology, 11/e

Directional Terms

Directional Terms: describes the position of a body part relative to another

- **Superior** (cephalic or cranial): Toward the head; upper part of structure.
- **Inferior** (caudal): Away from head; lower part of structure.

- **Anterior** (ventral): Nearer to or the front of the body.
- **Posterior** (dorsal): Nearer to or the back of the body.

- **Medial**: Nearer to the middle (imaginary line).
- **Lateral:** Farther from the middle.

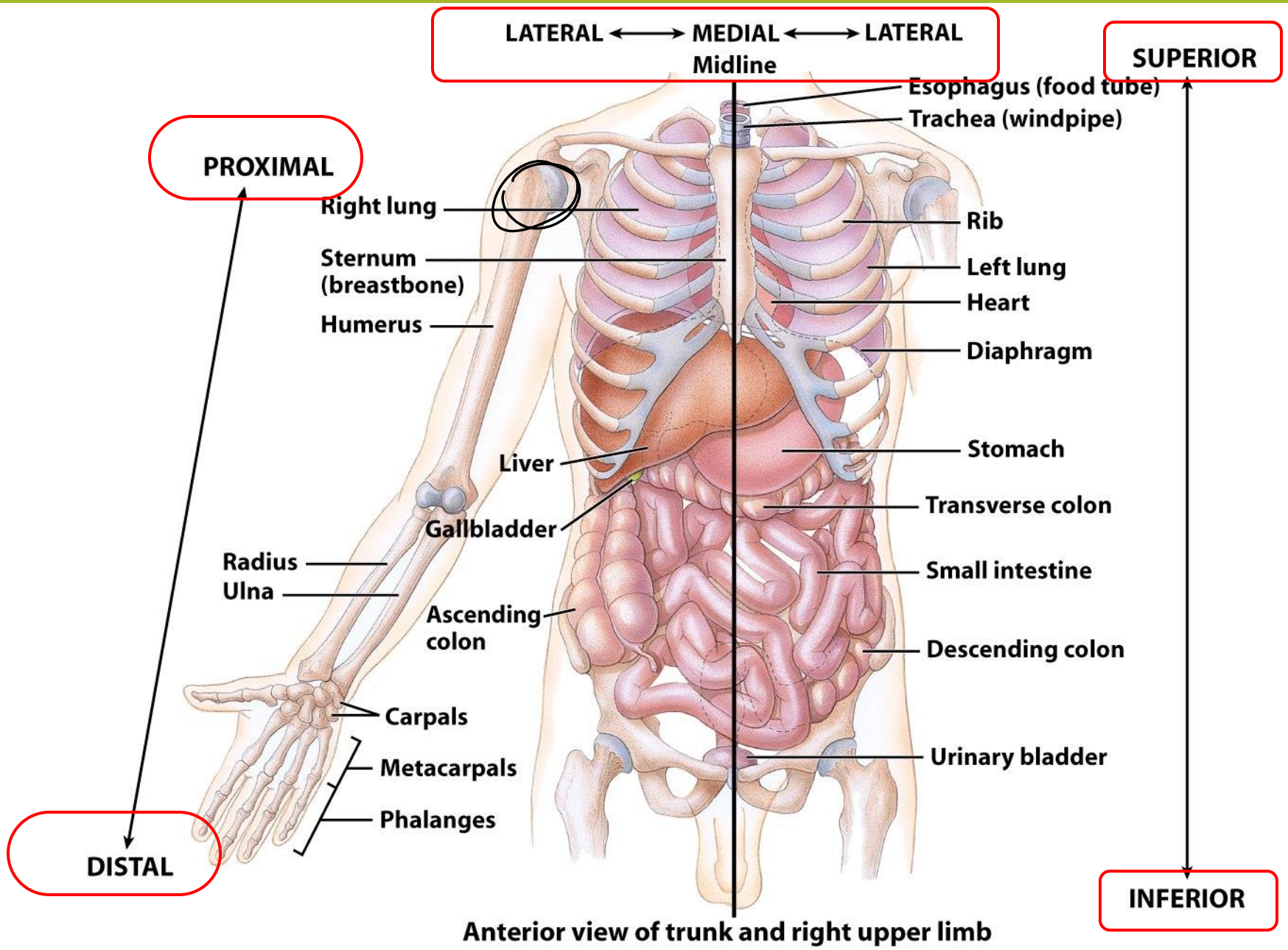
Directional Terms

- **Intermediate:** Between two structures.

- **Ipsilateral:** On the same side of the body as another structure.
- **Contralateral:** On the opposite side of the body as another structure

- **Proximal:** Nearer to the attachment of a limb to the trunk; nearer to the origination of a structure.
- **Distal**: Farther from the attachment of a limb; farther from the origination of a structure.

- **Superficial** (external): Towards or on the surface of body.
- **Deep** (internal): Away from the surface of the body.



Anterior view of trunk and right upper limb

Figure 1-6 Principles of Anatomy and Physiology, 11/e

Planes and Sections

- **Planes:** imaginary flat surfaces that pass through the body.
- **Sagittal plane:** vertical plane that divides the body or organ into right and left sides.
- **Midsagittal or median plane:** plane passes through the midline of the body or organ and divides into equal sides.
- **Midline:** Imaginary vertical line that divides the body into equal left and right.
- **Parasagittal plane:** does not pass midline but divides body or organ into unequal sides.

Planes and Sections

Section: cut of the body or organ made along one of the planes (midsagittal, frontal, transverse).

منتصف الجسم امامياً عرضياً

Frontal (coronal) plane:

- ✓ divides the body into anterior (front) and posterior (back) portions.

Transverse (cross-sectional, horizontal) plane:

- ✓ divides the body into superior (upper) and inferior (lower) portions.

Oblique plane:

- ✓ passes through body or organ at an angle other than 90o.

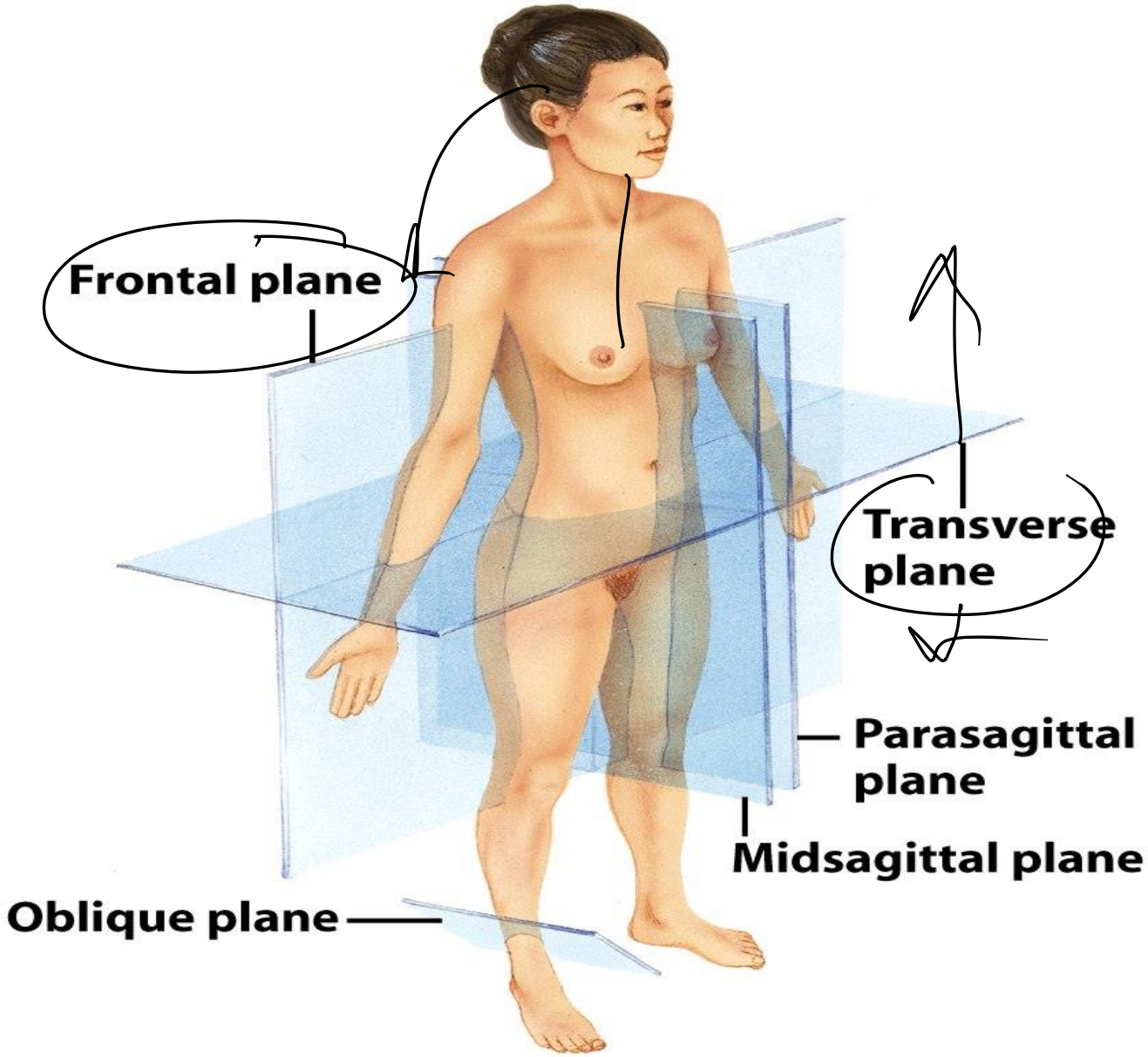


Figure 1-7 Principles of Anatomy and Physiology, 11/e

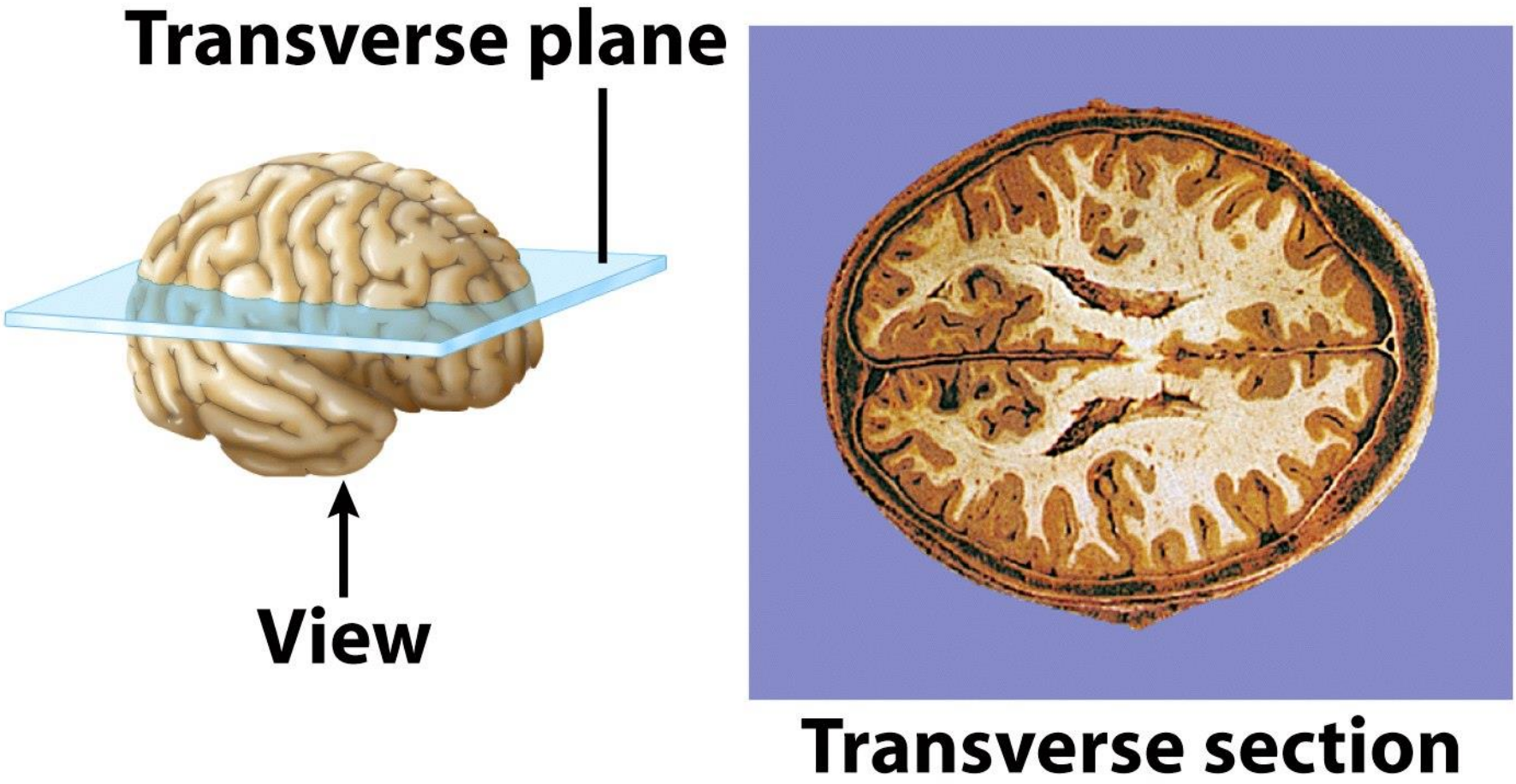


Figure 1-8a Principles of Anatomy and Physiology, 11/e

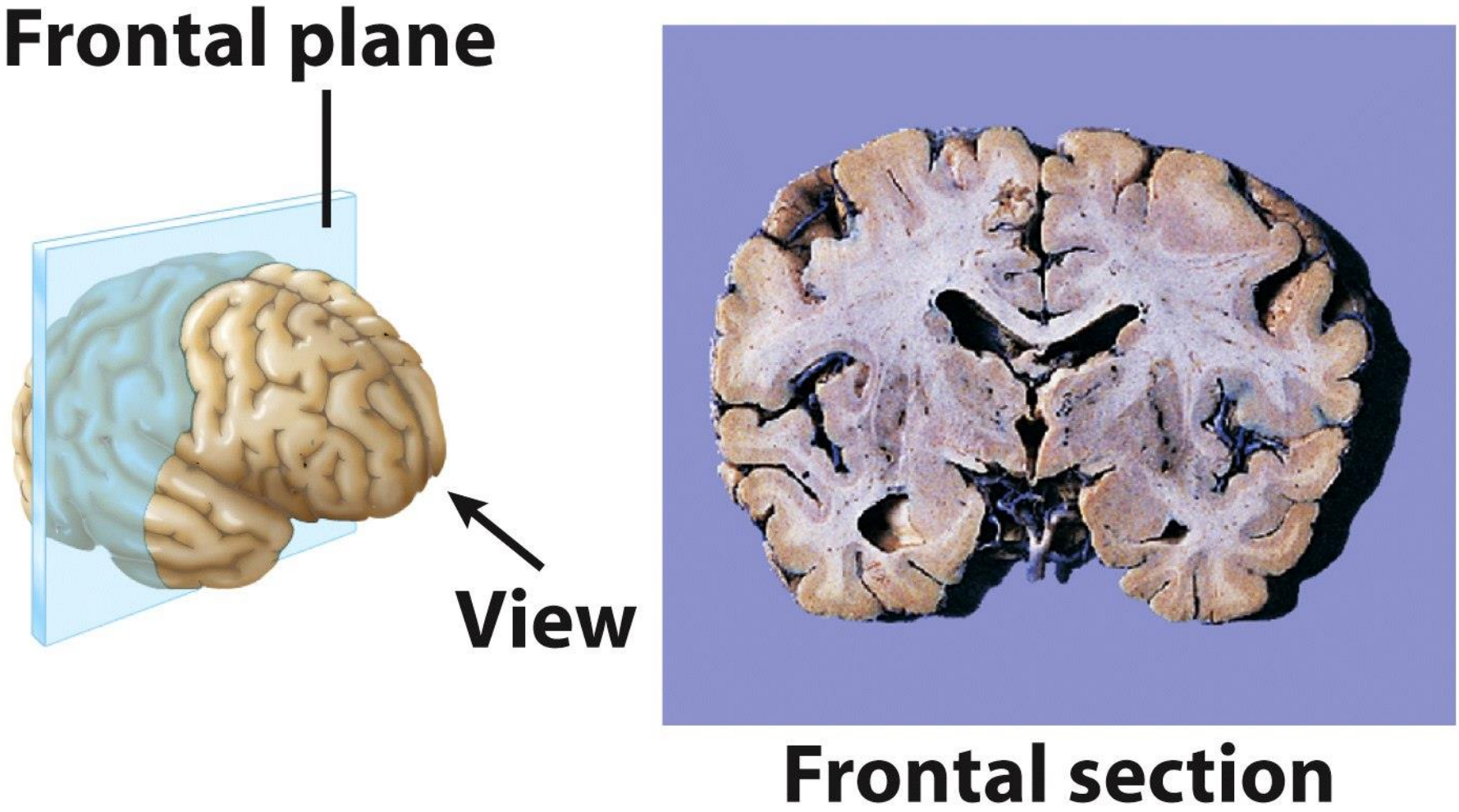


Figure 1-8b Principles of Anatomy and Physiology, 11/e

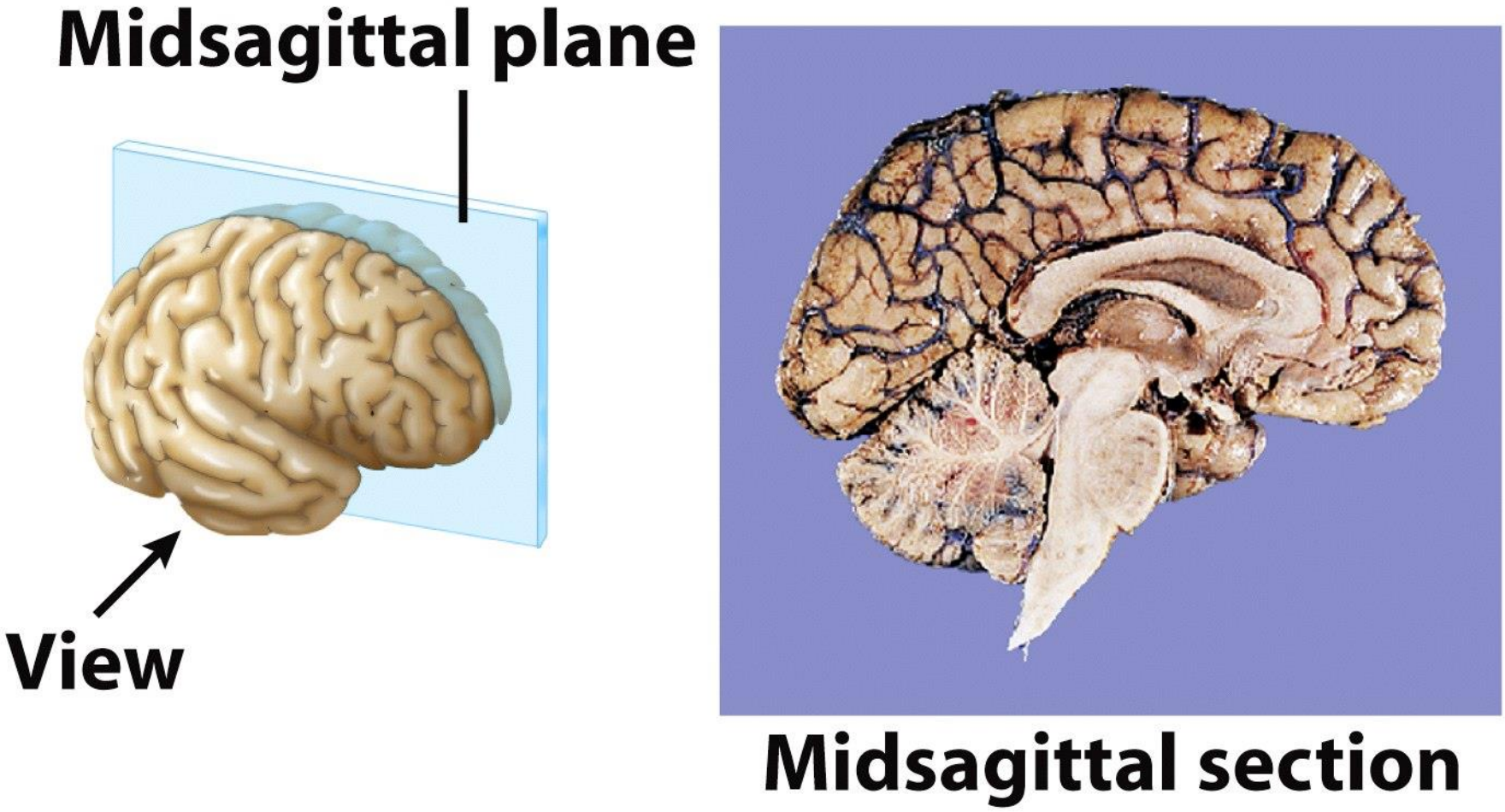


Figure 1-8c Principles of Anatomy and Physiology, 11/e

Body Cavities

تَجويف

المساحات التي تحيط بالعضو الداخلي

Body Cavities: spaces that enclose the internal organ

1. **Cranial Cavity**: Contains the brain.
   تجويف الجمجمة
2. **Vertebral (spinal) canal**: Contains the spinal cord.
   القناة الفقرية (العمود الفقري)

- The cranial and vertebral are continuous with one another.
- **Meninges**: Along with three layers of tissue and shock absorbing fluid surround the brain and spinal cord

سحايا

Body Cavities

تتكون من الأضلاع،

عضلات الصدر والقص والجزء الصدري من العمود الفقري

التجويف الصدري

Thoracic cavity (chest cavity): formed by ribs, the muscles of chest, the sternum, and thoracic portion of vertebral column.

1. **Pericardial cavity:** fluid filled space that surrounds the heart.

تجاويف الجنبية

2. **Pleural cavities:** One around each lung.
3. **Mediastinum:** Middle of thoracic cavity. Contains all thoracic organs except lungs. Heart, esophagus, trachea, thymus, large blood vessels from heart.
4. **Diaphragm:** dome-shaped muscle that separates thoracic cavity from the abdominopelvic cavity.

عضلة على شكل قبة تفصل التجويف الصدري من التجويف البطني الحوضي

Body Cavities

التجويف البطني الحوضي: من الحجاب الحاجز إلى الفخذ و

محاط بجدار عضلات البطن والعظام والعضلات

Abdominopelvic cavity: from diaphragm to groin and من الحوض encircled by abdominal muscle wall and bones and muscles of the pelvis.

1. **Abdominal cavity** (superior): contains stomach, spleen, liver, gallbladder, small intestines, and most of large intestines.
2. **Pelvic cavity** (inferior): urinary bladder, portions of large intestine, internal organs of reproductive system.

- **Viscera:** organs in the thoracic and abdominopelvic cavities.

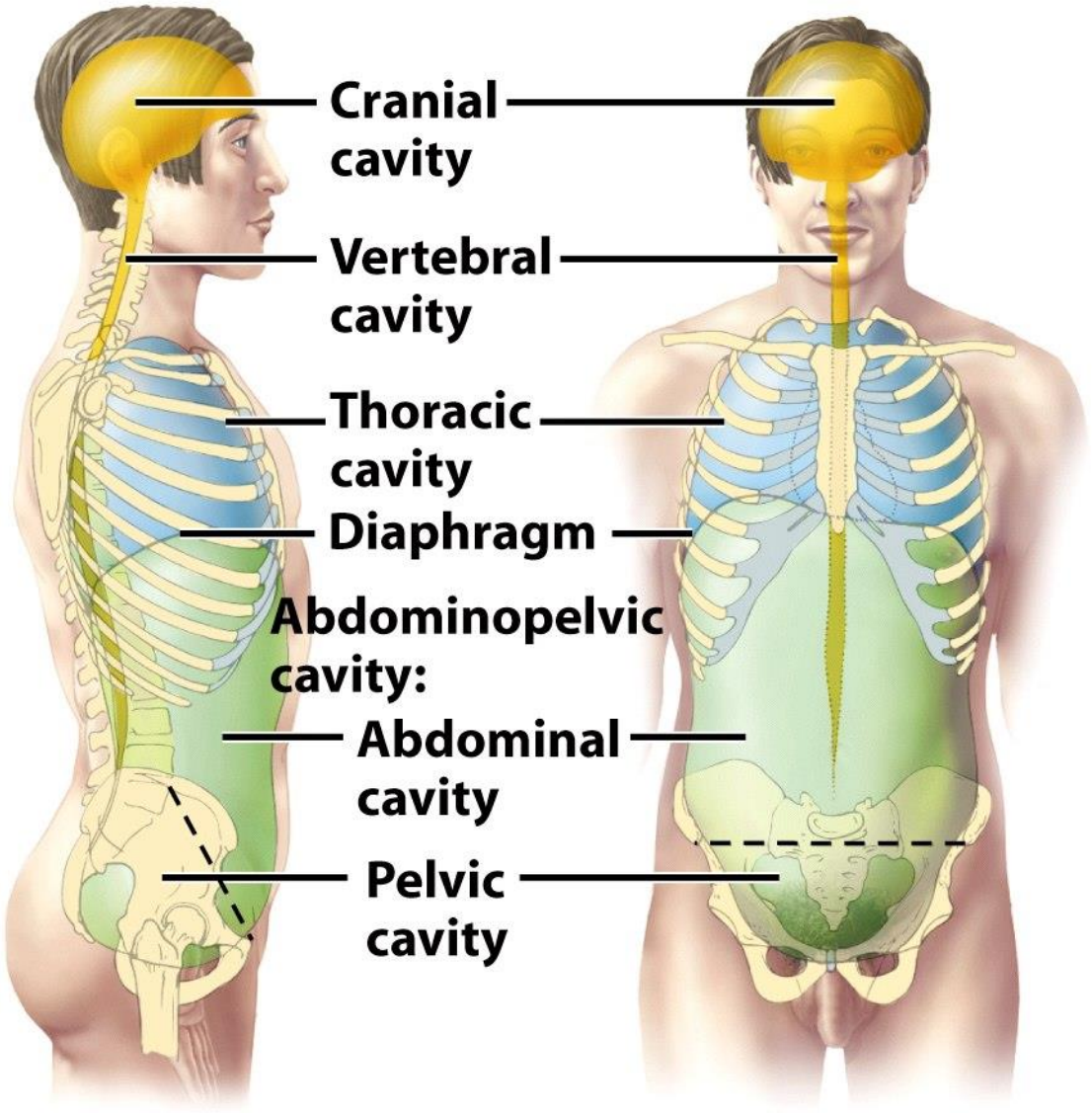


Figure 1-9 part 1 Principles of Anatomy and Physiology, 11/e

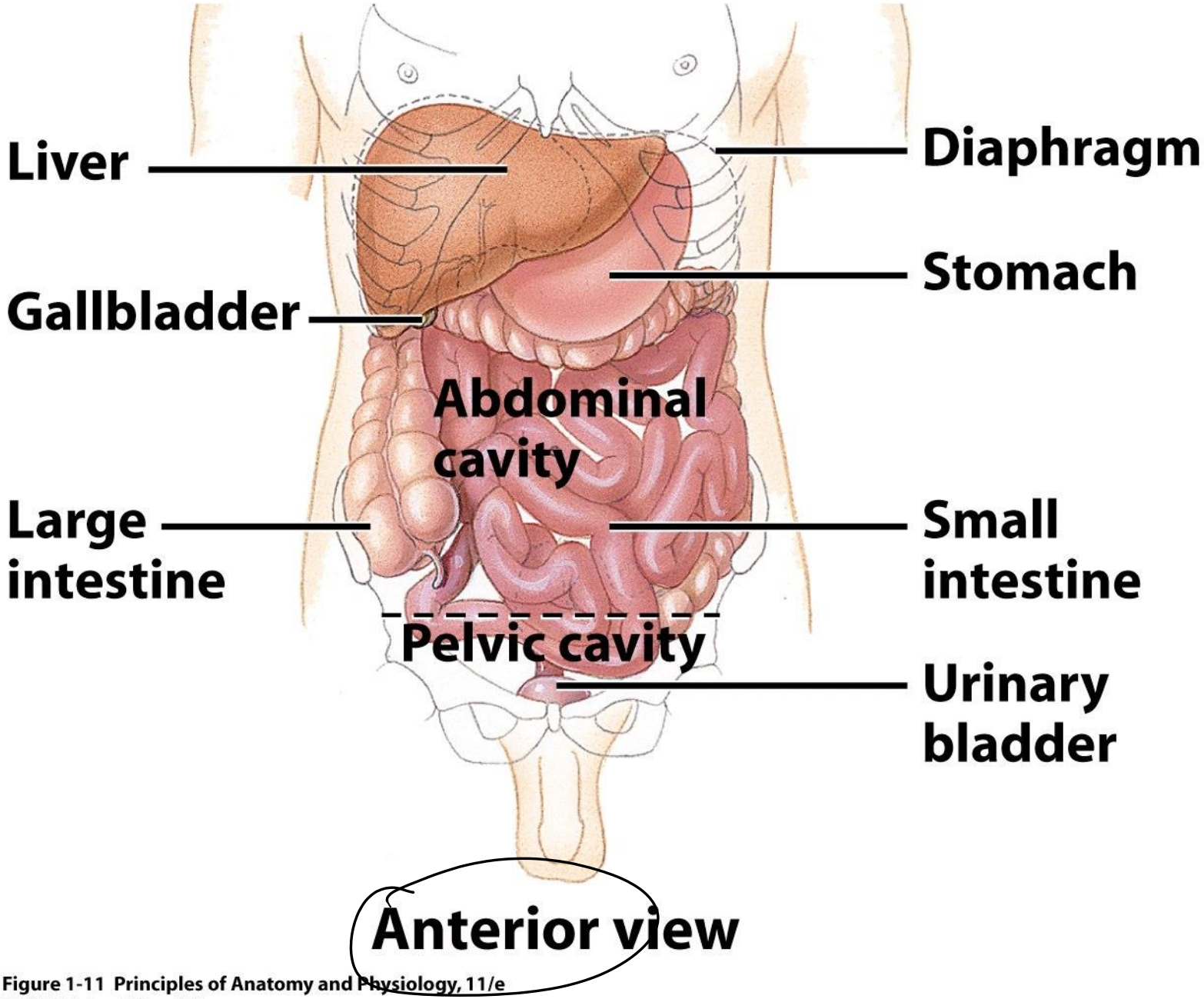
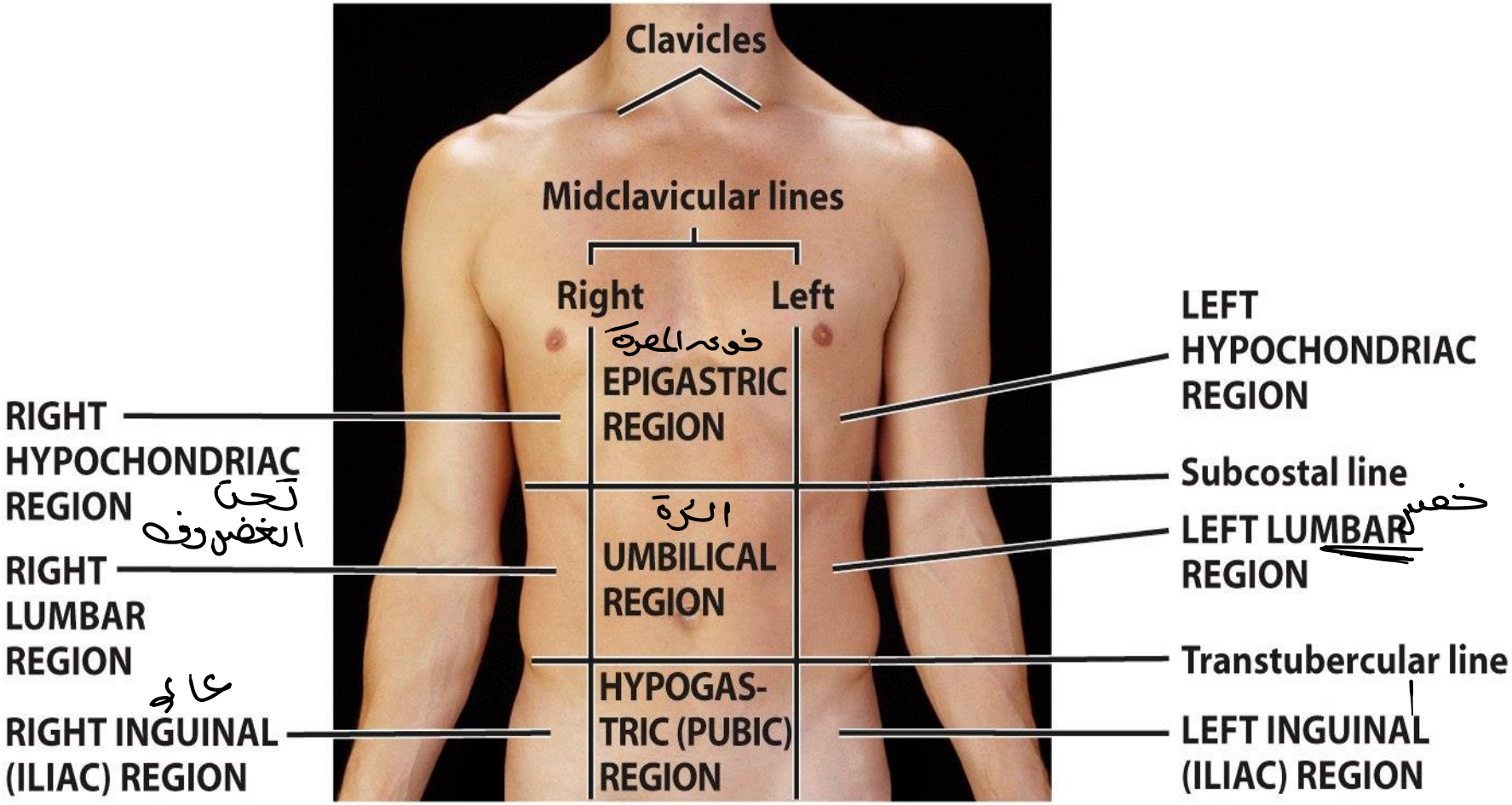
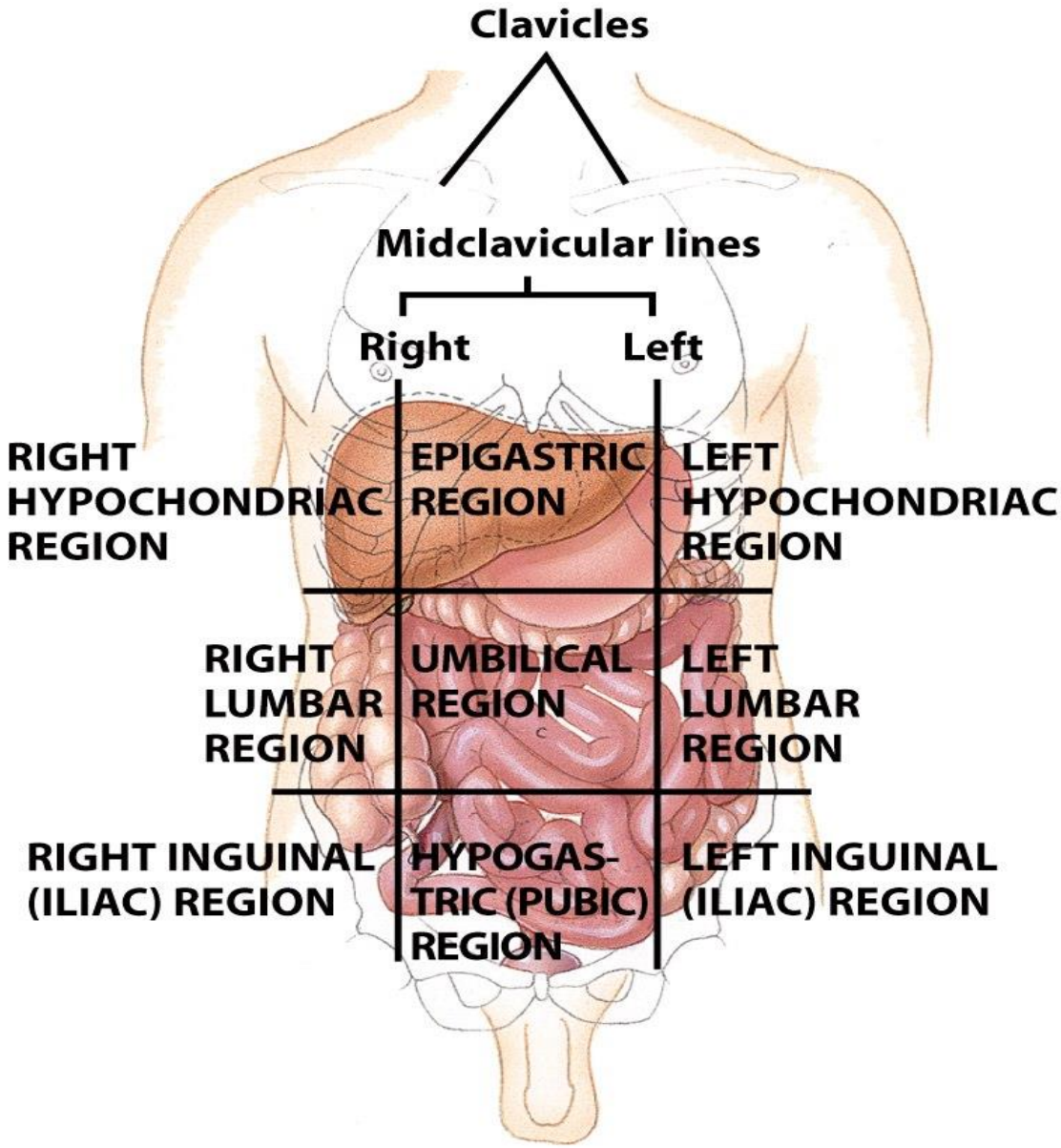


Figure 1-11 Principles of Anatomy and Physiology, 11/e



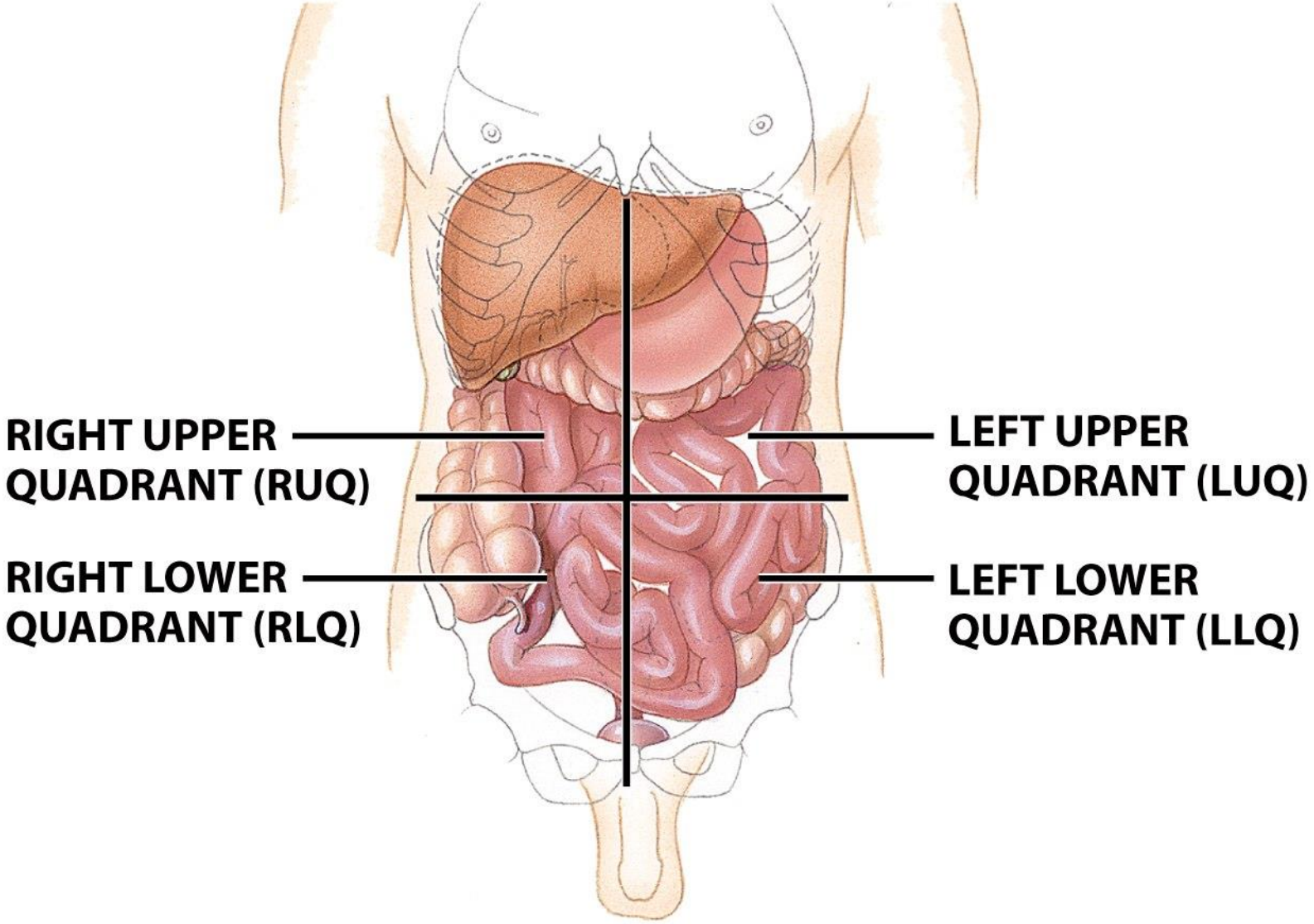
Anterior view showing abdominopelvic regions

Figure 1-12a Principles of Anatomy and Physiology, 11/e



Anterior view showing location of abdominopelvic regions

Figure 1-12b Principles of Anatomy and Physiology, 11/e



Anterior view showing location of abdominopelvic quadrants

Figure 1-12c Principles of Anatomy and Physiology, 11/e

Chapter 3

The skeletal System

Hamza Abu Hilail
M.Sc. Physiology

Bone

- Bone is a living tissue which **consists of** cells, fibers, and matrix.

إنه صعب بسبب تكلس خارج الخلية

المصفوفة وتمتلك درجة من المرونة بسبب

- It is **hard** because of the **calcification** of its extracellular matrix & possesses a degree of elasticity because of the presence of organic fibers.

وجود ألياف عضوية.

1. وظيفة الحماية.

Functions of bones:

2. إنه بمثابة رافعة، كما هو موضح في العظام الطويلة للأطراف.

1. Protective function.
2. It serves as a lever, as seen in the long bones of the limbs.

العوام

3. الجهاز الحركي.
4. منطقة تخزين لأملاح الكالسيوم.
3. Locomotor system.
4. Storage area for calcium salts.

5. إنه يضم ويحمي داخل تجاويفه العظام

5. It houses and protects within its cavities the bone marrow.

نخاع.

Bone

أشكال العظام

➢ **Bone exists in two forms:**

الصلب

❑ **Compact bone** appears as a solid mass.

❑ **Cancellous bone** consists of a branching network of trabeculae.

تجاني اسفنج

➢ Classification of Bones

Bones may be classified according to:

1. **Regional classification.** التصنيف الإقليمي

2. **General shape classification.** تصنيف الشكل العام.

A. Long Bones → طويلة

B. Short Bones → قصيرة

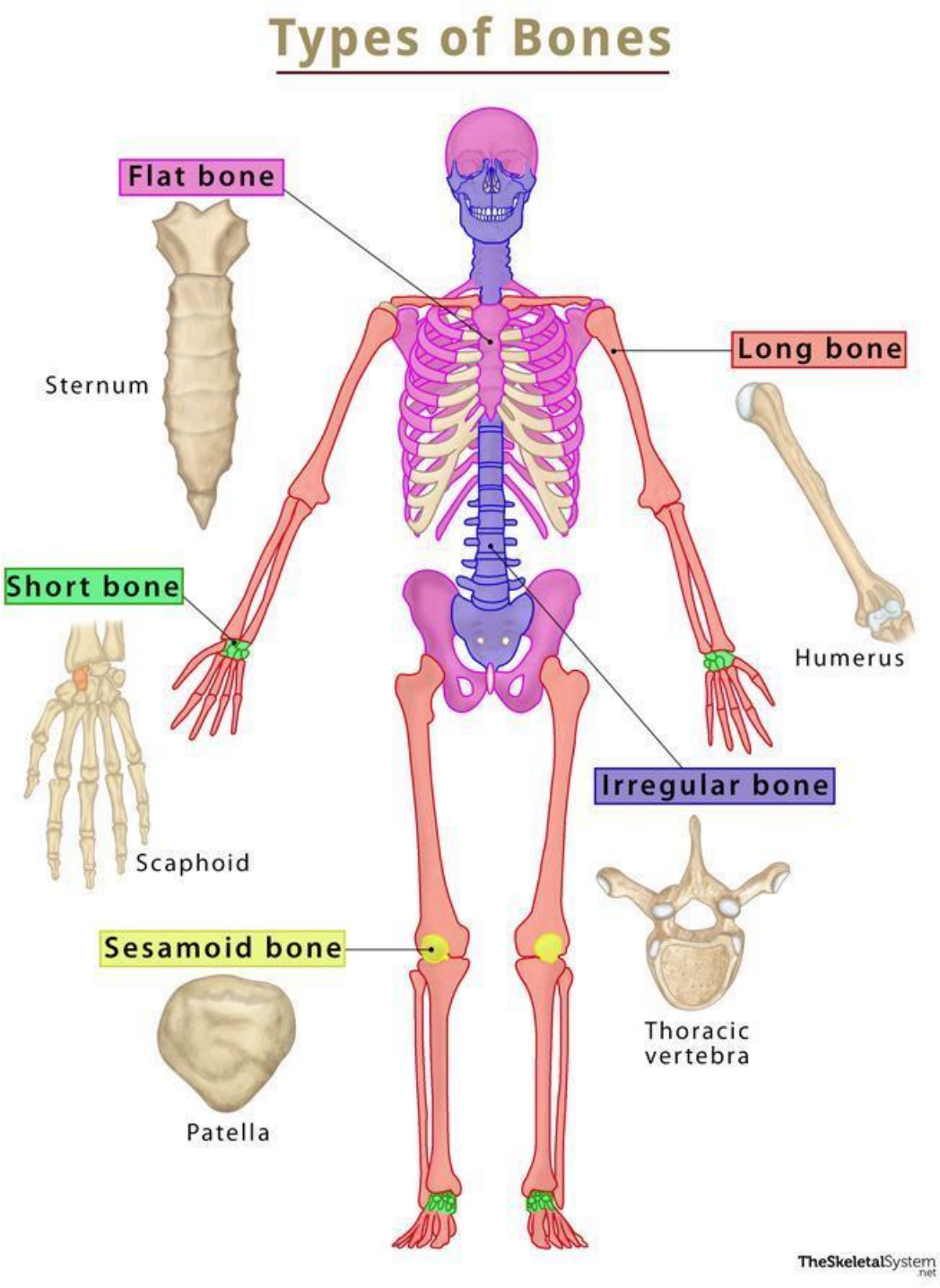
C. Flat Bones → مسطحة

D. Irregular Bones → غير منتظم

E. Sesamoid Bones → سمسمية

أمثلة

Classification of Bones



Long Bones

طولهم أكبر من عرضهم

- Their length is greater than their breadth.

لديهم عمود أنبوبي، diaphysis، وعادة ما يكون

- They have a tubular **shaft**, the **diaphysis**, and usually an **epiphysis** at each end.

المشاش في كل نهاية

يحتوي العمود على تجويف نخاع مركزي يحتوي على عظم

- The shaft has a central marrow cavity containing bone marrow.

نخاع

يتكون الجزء الخارجي من العمود من عظم مضغوط

الذي يغطيه غمد النسيج الضام،

- The outer part of the shaft is composed of **compact bone** that is covered by a connective tissue sheath, the periosteum.

السمحاق

الأسطح المفصلية لنهايات العظام مغطاة

بواسطة الغضروف الهيالين.

- The articular surfaces of the ends of the bones are covered by **hyaline cartilage.**

Flat Bones

إنها تتكون من رقيقة

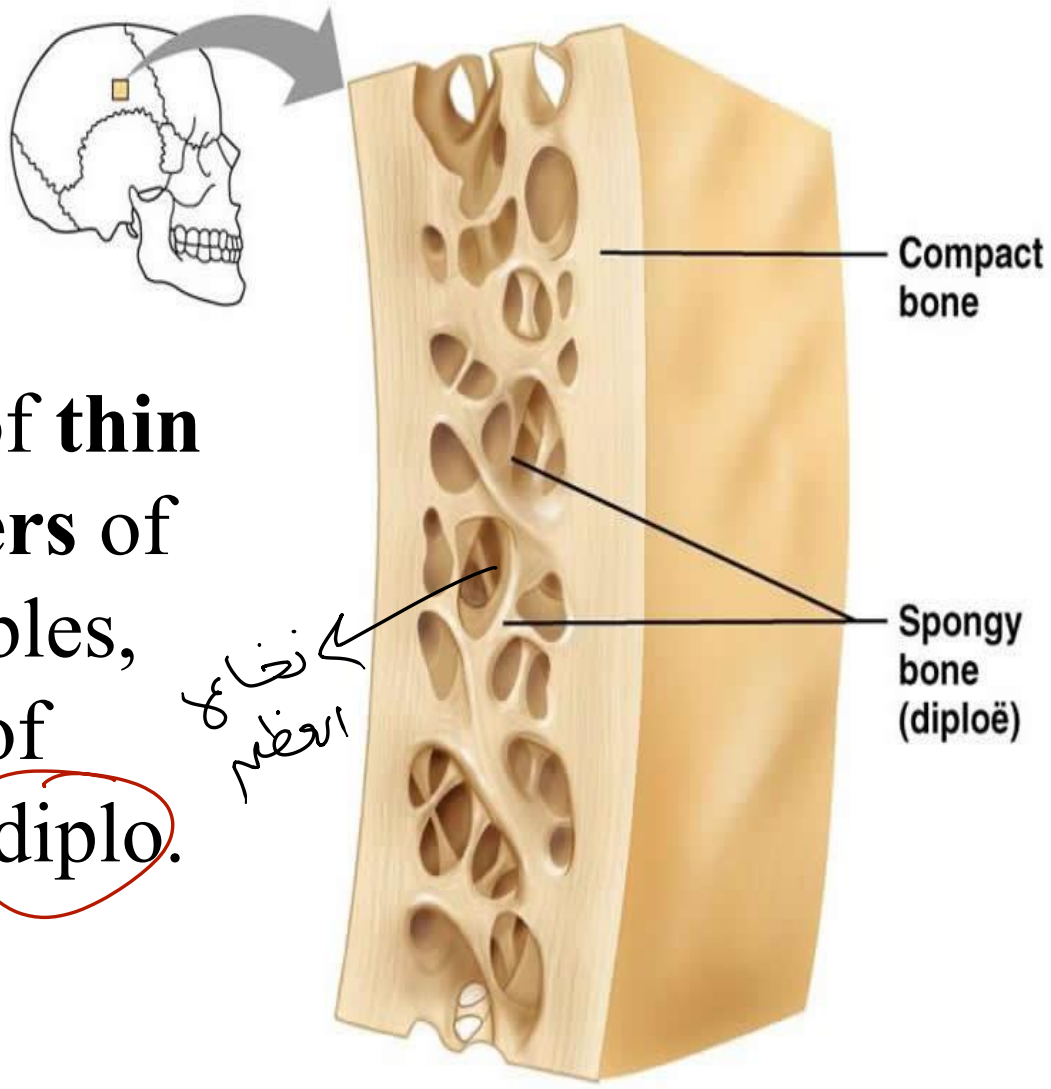
الطبقات الداخلية والخارجية من

عظم مضغوط، الطاولات،

مفصولة بطبقة من

عظم إسفنجي، ديبلو

They are composed of **thin inner and outer layers** of compact bone, the tables, separated by a layer of cancellous bone, the diplo.



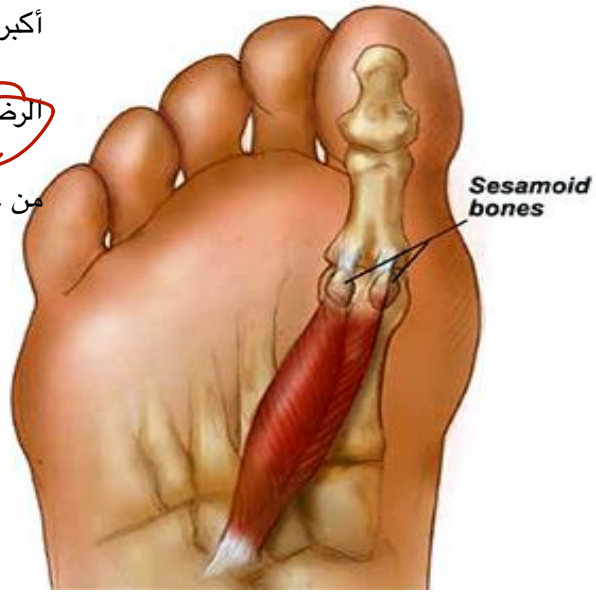
عظام السمسم

Sesamoid Bones

• العظام السمسمية هي عقيدات صغيرة من العظام الموجودة في بعض الأوتار حيث يفركون على الأسطح العظمية الجزء الأكبر من العظم السمسمي هو مدفون في الوتر، والحر السطح مغطى بالغضروف.

- Sesamoid bones are small nodules of bone that are found in certain tendons where they rub over bony surfaces.
- The greater part of a sesamoid bone is buried in the tendon, and the free surface is covered with cartilage.
- The largest sesamoid bone is the **patella**, which is located in the tendon of the quadriceps femoris.

أكبر عظمة سمسمية هي الرضفة، التي تقع في الوتر من عضلات الفخذ الرباعية.



The function of a sesamoid bone is:

1. Reduce friction on the tendon.
2. Alter the direction of pull of a tendon.

Structure of The Long Bone

1. الحجاب الحمي: هو العمود أو الجسم، الطويل،

أسطواني، الجزء الرئيسي من العظم

1. **The diaphysis**: is the shaft or body, the long, cylindrical, main portion of the bone.

2. المشاشات: هي القريبة والبعيدة

نهايات العظم

2. **The epiphyses**: are the proximal and distal ends of the bone.

3. الميتافيسيس: هي المناطق الواقعة بين

Diaphysis و epiphyses

3. **The metaphysis**: are the regions between the diaphysis and the epiphyses.

Structure of The Long Bone

• حوالي سن 18-21، الغضروف في المشاش

يتم استبدال اللوحة بالعظام؛ العظم الناتج

يعرف الهيكل باسم الخط المشاشي

- About ages 18–21, the cartilage in the epiphyseal plate is replaced by bone; the resulting bony structure is known as the **epiphyseal line.**

4. الغضروف المفصلي: عبارة عن طبقة رقيقة من الهيالين

الغضروف الذي يغطي جزء من المشاش حيث

يشكل العظم مفصلا (مفصلا) مع عظمة أخرى

4. The articular cartilage: is a thin layer of hyaline cartilage covering the part of the epiphysis where the bone forms an articulation (joint) with another bone.

- Articular cartilage reduces friction and absorbs shock at freely movable joints

يقلل الغضروف المفصلي من الاحتكاك ويمتص الصدمات

في المفاصل المتحركة بحرية

Structure of The Long Bone

5. السمحاق: هو غمد النسيج الضام و إمدادات الدم المرتبطة التي تحيط بسطح العظام

5. The periosteum: is a connective tissue sheath and its associated blood supply that surrounds the bone surface

العظم مصنوع من ألياف الكولاجين المليئة بالمعادن، أملاح الكالسيوم بشكل أساسي

- Bone is made of collagen fibers filled with minerals, mainly calcium salts

البروتين الليفي ذو القوة الكبيرة التي هي المكون الرئيسي للعظام

- **Collagen:** A fibrous protein with great strength that is the main component of bone.
- **Calcium:** The mineral stored in bone keeps it hard and strong.

✓99% of the body's calcium is stored in bone

Structure of The Long Bone

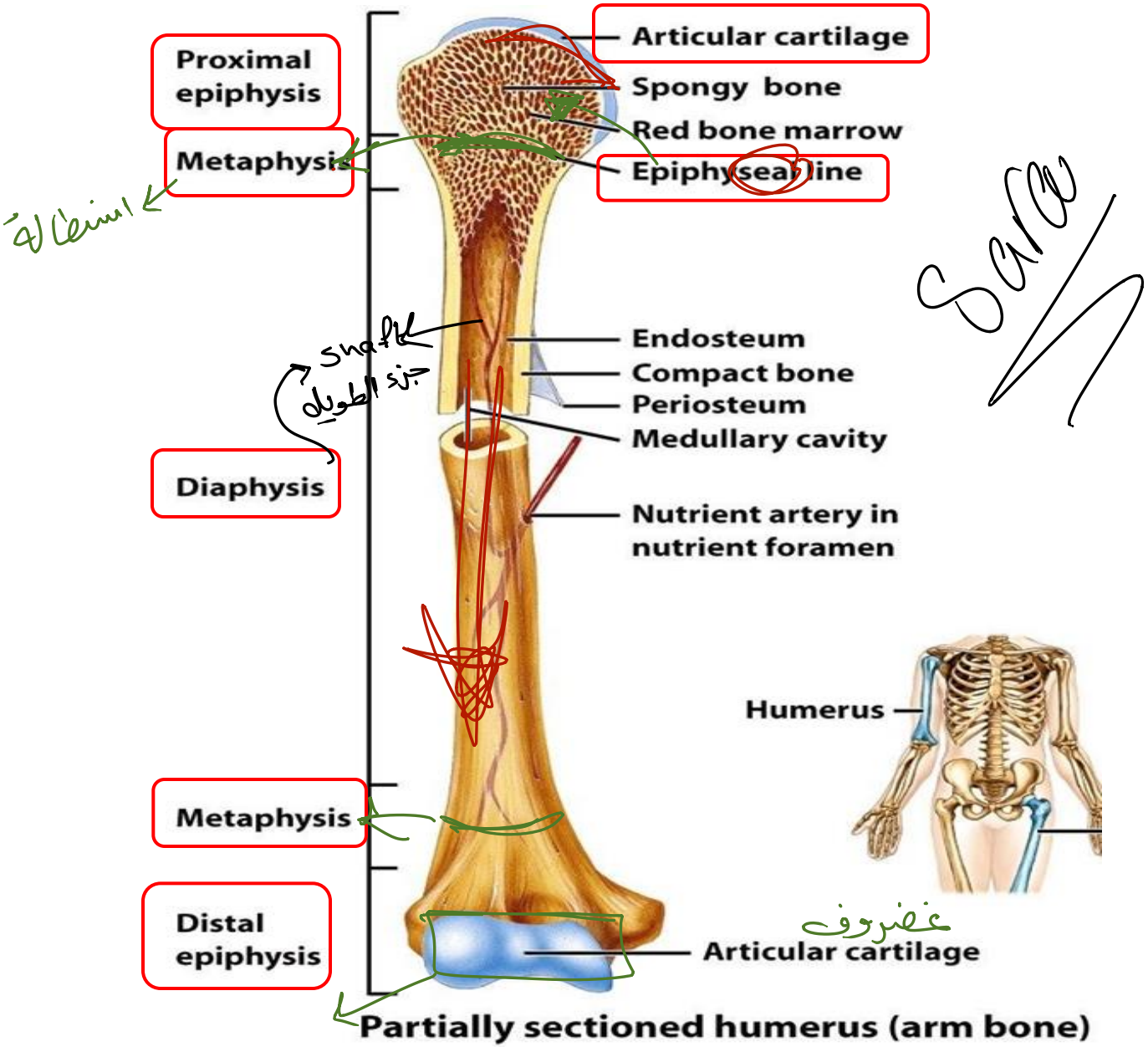


Figure 6-1a Principles of Anatomy and Physiology, 11/e

Bone cells

osteosaet ← تكون العظم

1. Osteogenic (producing) :

الخلايا الجذعية غير المتخصصة، الخلايا الناتجة تتطور إلى بانيات العظم

- ✓ Unspecialized stem cell, resulting cells developing into osteoblasts

خلايا ناضجة وجذعية

2. Osteoblasts (secrete extracellular matrix)

خلايا ناضجة

خارج الخلية

- ✓ Bone-building cells, build the extracellular matrix of bone tissue

الخلايا العظمية (تحافظ على الأنسجة)

Osteocytes (maintain the tissue)

- ❑ mature bone cells

❑ خلايا العظام الناضجة

- ❑ خلايا ضخمة مشتقة من الخلايا الوحيدة (WBC)، تهضم البروتين و المكون المعدني لمصفوفة العظام الأساسية

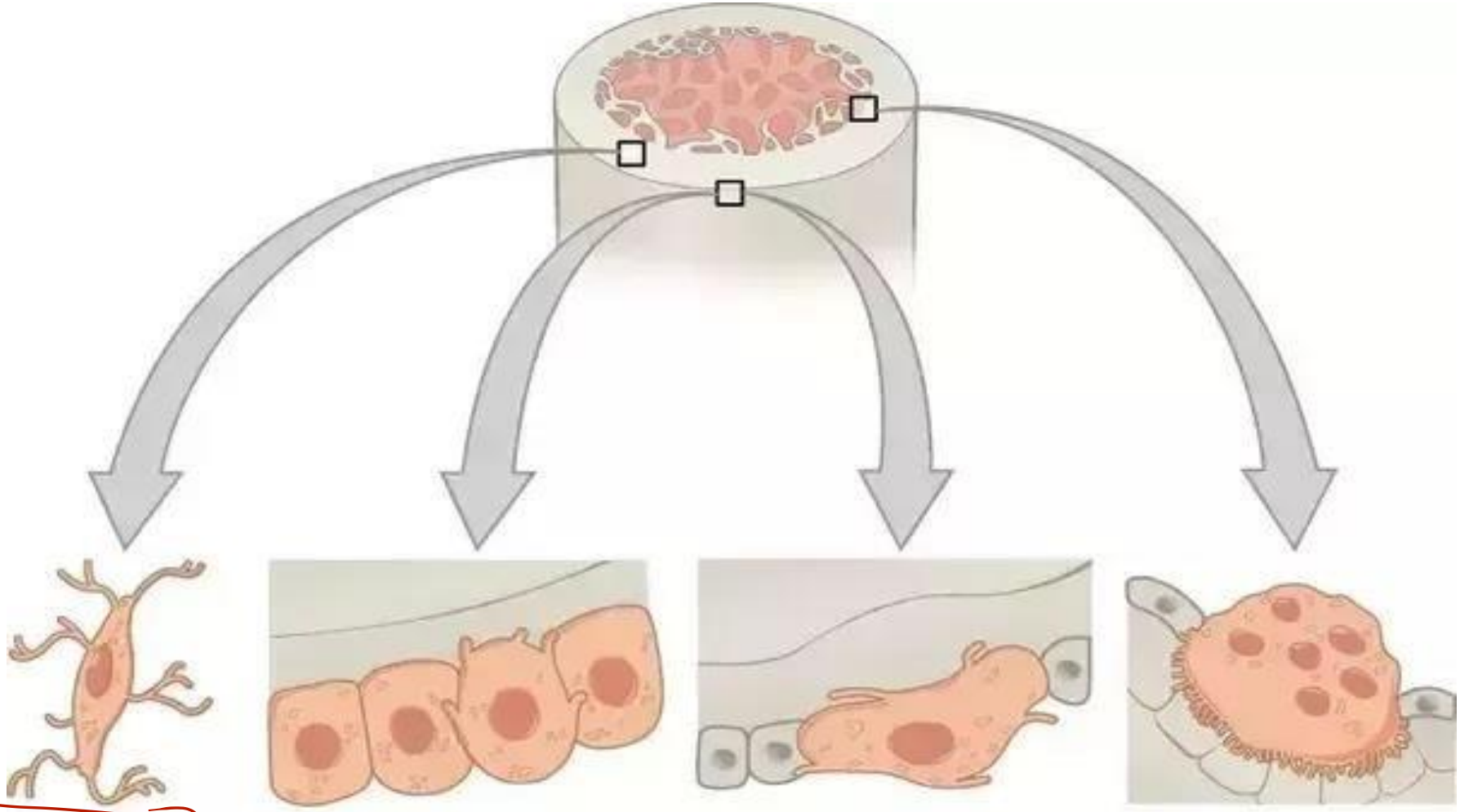
3. Osteoclasts (breakdown EC matrix):

اي خلية ضخمة وقوية او ضخمة تتخلص منها

- ❑ huge cells derived from monocytes(WBC), digest the protein and mineral component of the underlying bone matrix

الامتصاص

- ➢ **Resorption**: breakdown of bone EC matrix


Osteocyte
(maintains
bone tissue)
Osteoblast
(forms bone matrix)
Osteogenic cell
(stem cell)
Osteoclast
(resorbs bone)
تكون العظم

Types of Bone

1. Compact bone

- Compact bone tissue contains few spaces, it is the strongest form of bone tissue.

Compact bone functions:

- ✓ provides protection and support and resists the stresses produced by weight and movement.

- Compact bone tissue is composed of repeating structural units called **osteons**, or haversian systems .

1. عظم مضغوط

• تحتوي الأنسجة العظمية المدمجة على مساحات قليلة، وهي

أقوى شكل من الأنسجة العظمية.

وظائف العظام المدمجة:

✓ يوفر الحماية والدعم ويقاوم

الضغوط الناتجة عن الوزن والحركة.

• تتكون الأنسجة العظمية المدمجة من تكرار

وحدات هيكلية تسمى العظام، أو أنظمة هافرس.

Types of Bone

2. Spongy bone

- also referred to as trabecular or cancellous bone tissue

- does not contain osteons

- located in the interior of a bone, protected by a covering of compact bone

بين المساحات التربيقية المليئة بنخاع العظام الأحمر في

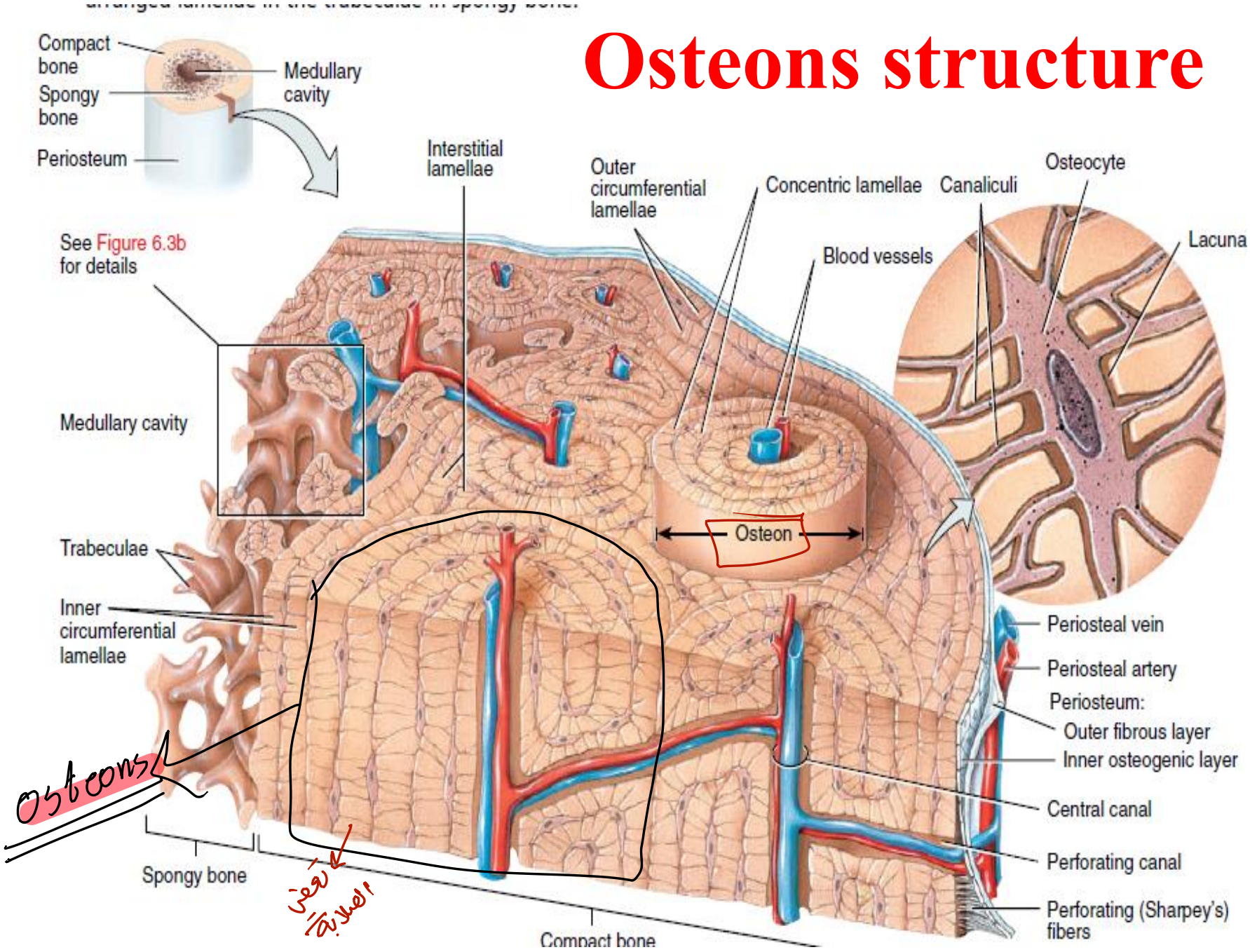
العظام التي تنتج خلايا الدم، ونخاع العظام الأصفر

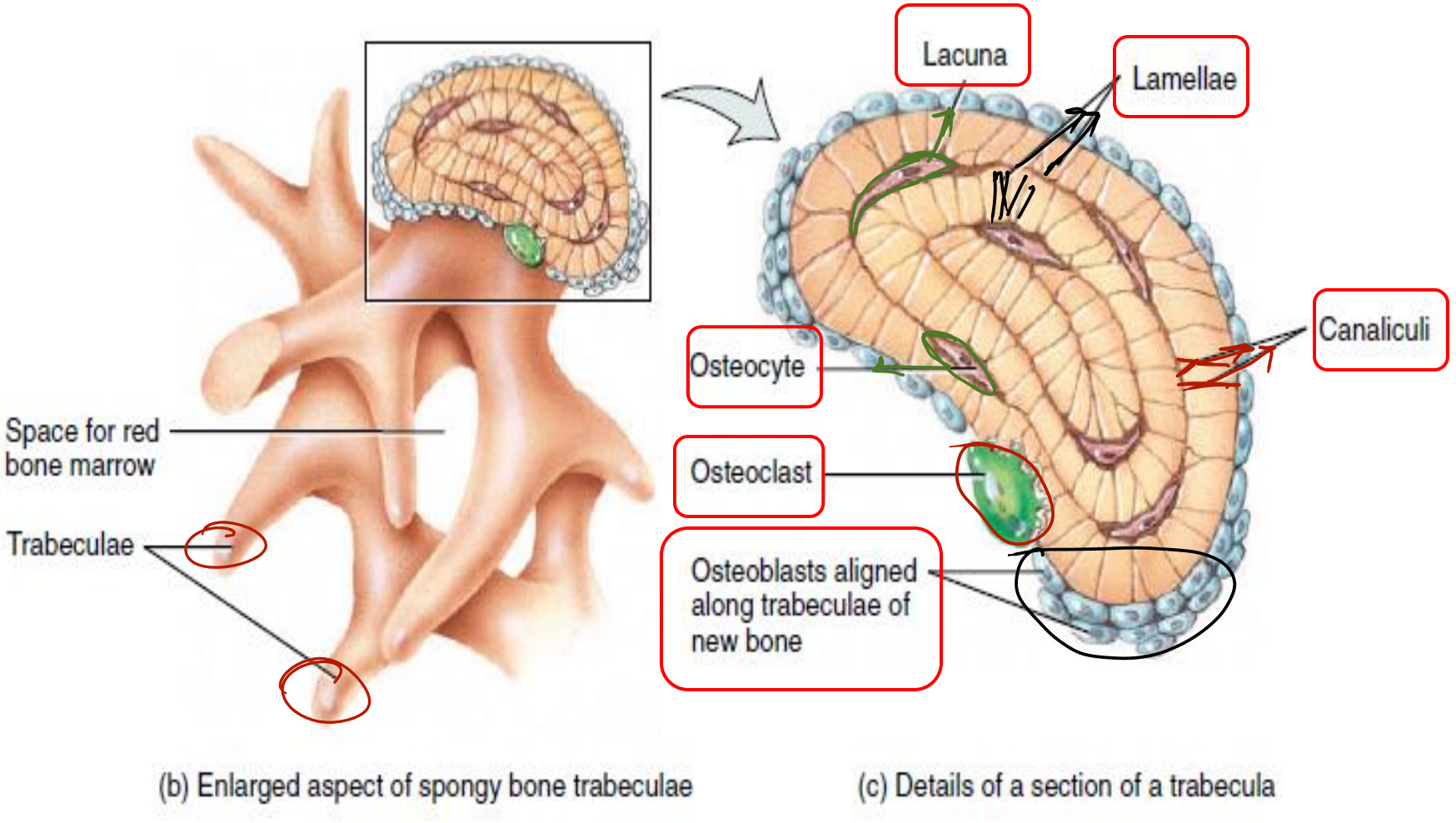
(الأنسجة الدهنية) في العظام الأخرى.

- It consists of trabeculae

- Between the trabeculae spaces filled with red bone marrow in bones that produce blood cells, and yellow bone marrow (adipose tissue) in other bones.

Osteons structure




Lacuna
Lamellae
Canaliculi
Osteocyte
Osteoclast
Osteoblasts aligned along trabeculae of new bone
Space for red bone marrow
Trabeculae
(b) Enlarged aspect of spongy bone trabeculae
(c) Details of a section of a trabecula

Factors Affecting Bone Growth and Bone Remodeling

- **Minerals** (calcium , phosphorus ,magnesium, fluoride, and manganese)

- **Vitamins.**

1. **Vitamin A** stimulates activity of osteoblasts.
2. **Vitamin C** is needed for synthesis of collagen, the main bone protein.
3. **Vitamin D** helps build bone by increasing the absorption of calcium from foods in the gastrointestinal tract into the blood.
4. **Vitamins K and B12** are also needed for synthesis of bone proteins.

بناء العظم

Sara Alzabali

The Skeletal System

Parts of the skeletal system

1. Bones (skeleton)
2. Joints
3. Cartilages
4. Ligaments (bone to bone)(tendon=bone to muscle)

- Composed of 206 bones and Divided into two divisions (Axial and Appendicular skeletons)

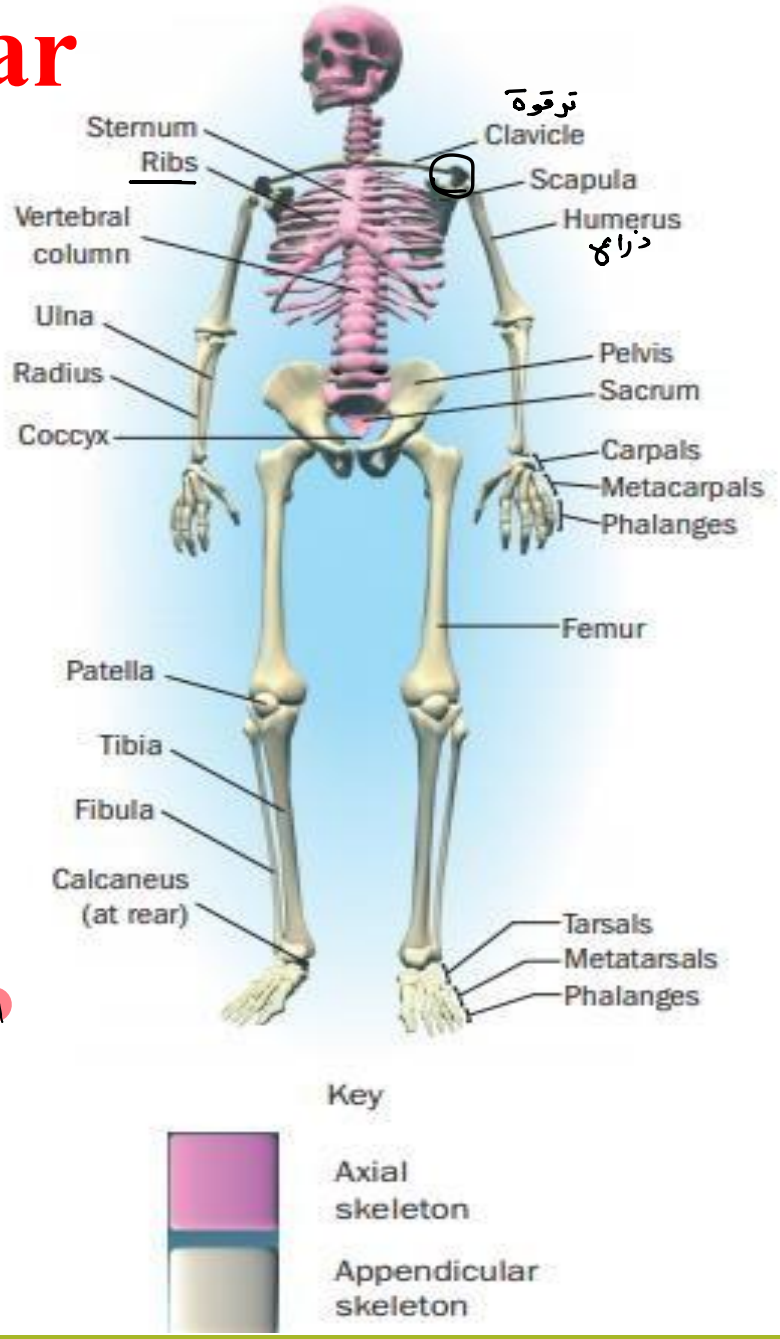
Axial and Appendicular skeletons

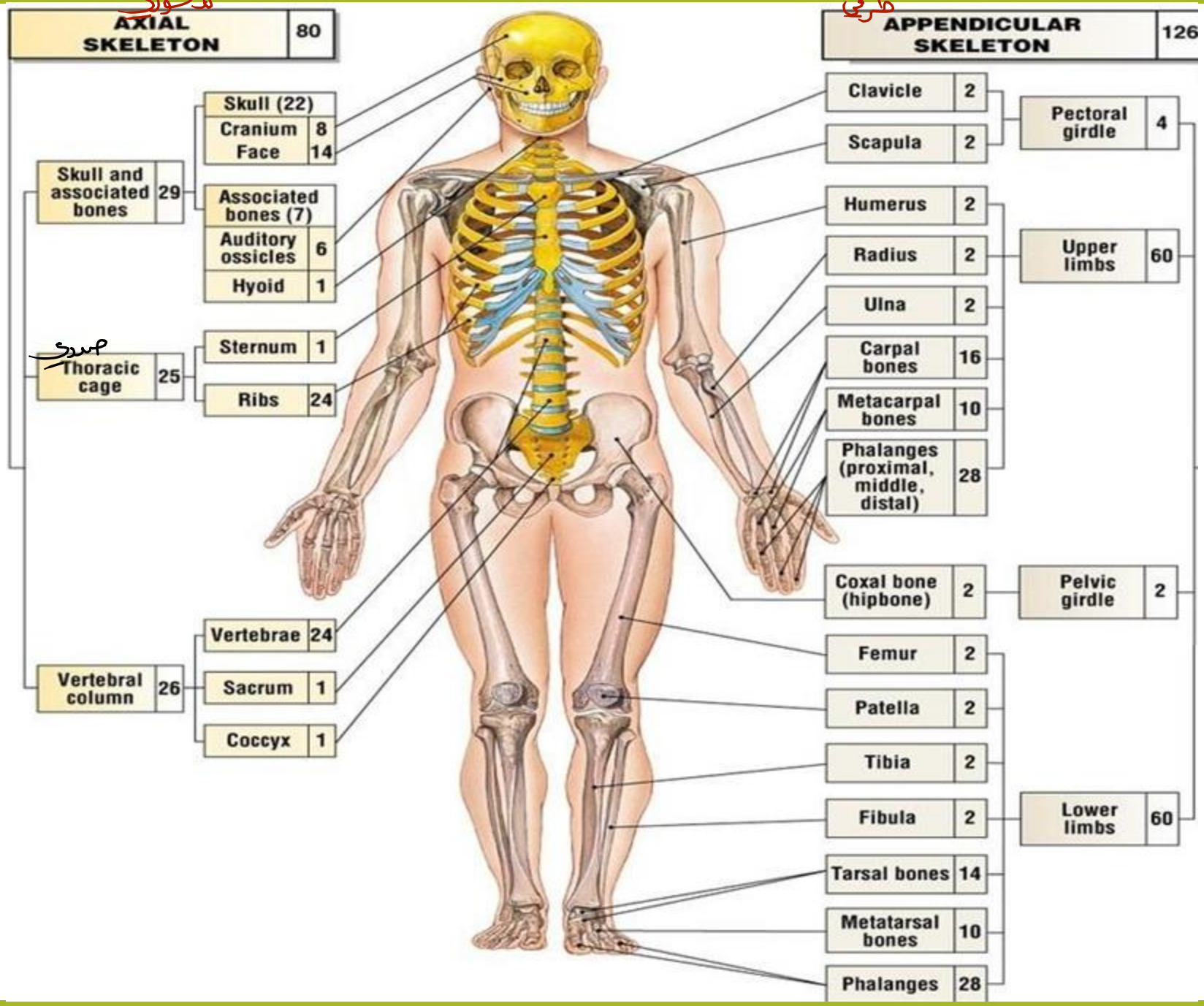
The Axial skeleton

1. Skull → جمجمة
2. Vertebral column → عمود فقري
3. Bony thorax → الصدر العظمي

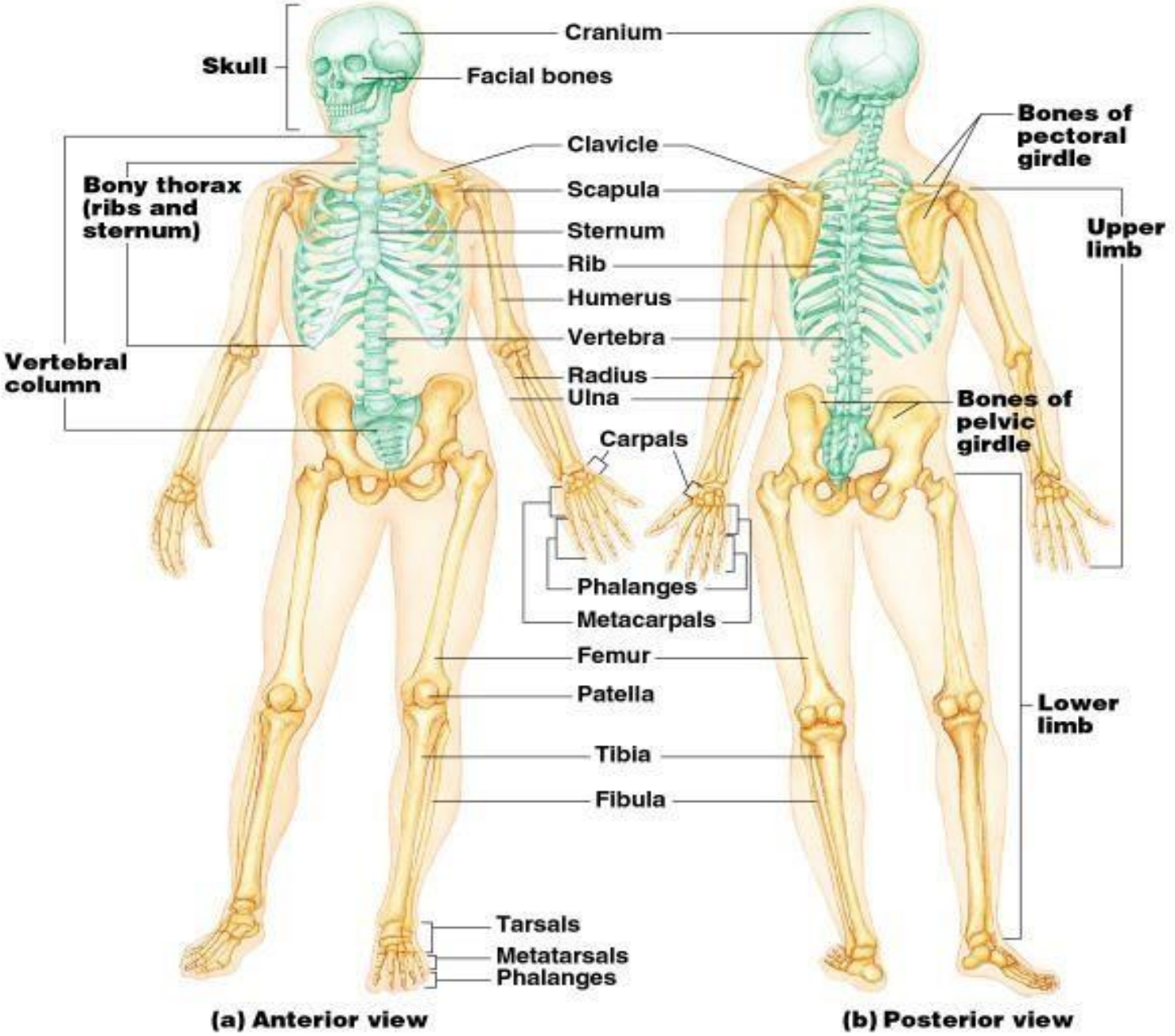
The Appendicular skeleton

1. Limbs (appendages) → أطراف
2. Pectoral girdle → حزام صدري
3. Pelvic girdle → حزام حوضي




محوري
AXIAL SKELETON 80
Skull and associated bones 29
Skull (22)
Cranium 8
Face 14
Associated bones (7)
Auditory ossicles 6
Hyoid 1
صدري
Thoracic cage 25
Sternum 1
Ribs 24
Vertebral column 26
Vertebrae 24
Sacrum 1
Coccyx 1
طرفي
APPENDICULAR SKELETON 126
Pectoral girdle 4
Clavicle 2
Scapula 2
Upper limbs 60
Humerus 2
Radius 2
Ulna 2
Carpal bones 16
Metacarpal bones 10
Phalanges (proximal, middle, distal) 28
Pelvic girdle 2
Coxal bone (hipbone) 2
Lower limbs 60
Femur 2
Patella 2
Tibia 2
Fibula 2
Tarsal bones 14
Metatarsal bones 10
Phalanges 28

The Axial skeleton



الجمجمة

The Skull

Two sets of bones

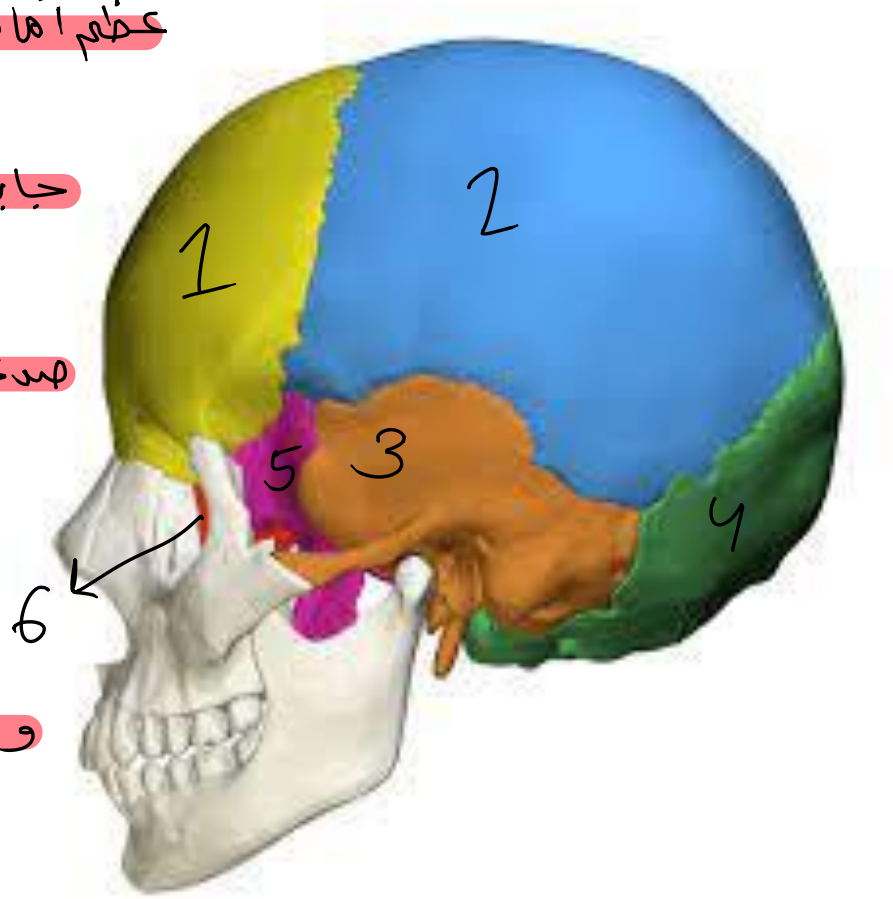
1. Cranium → Brain
2. Facial bones → عظام الوجه

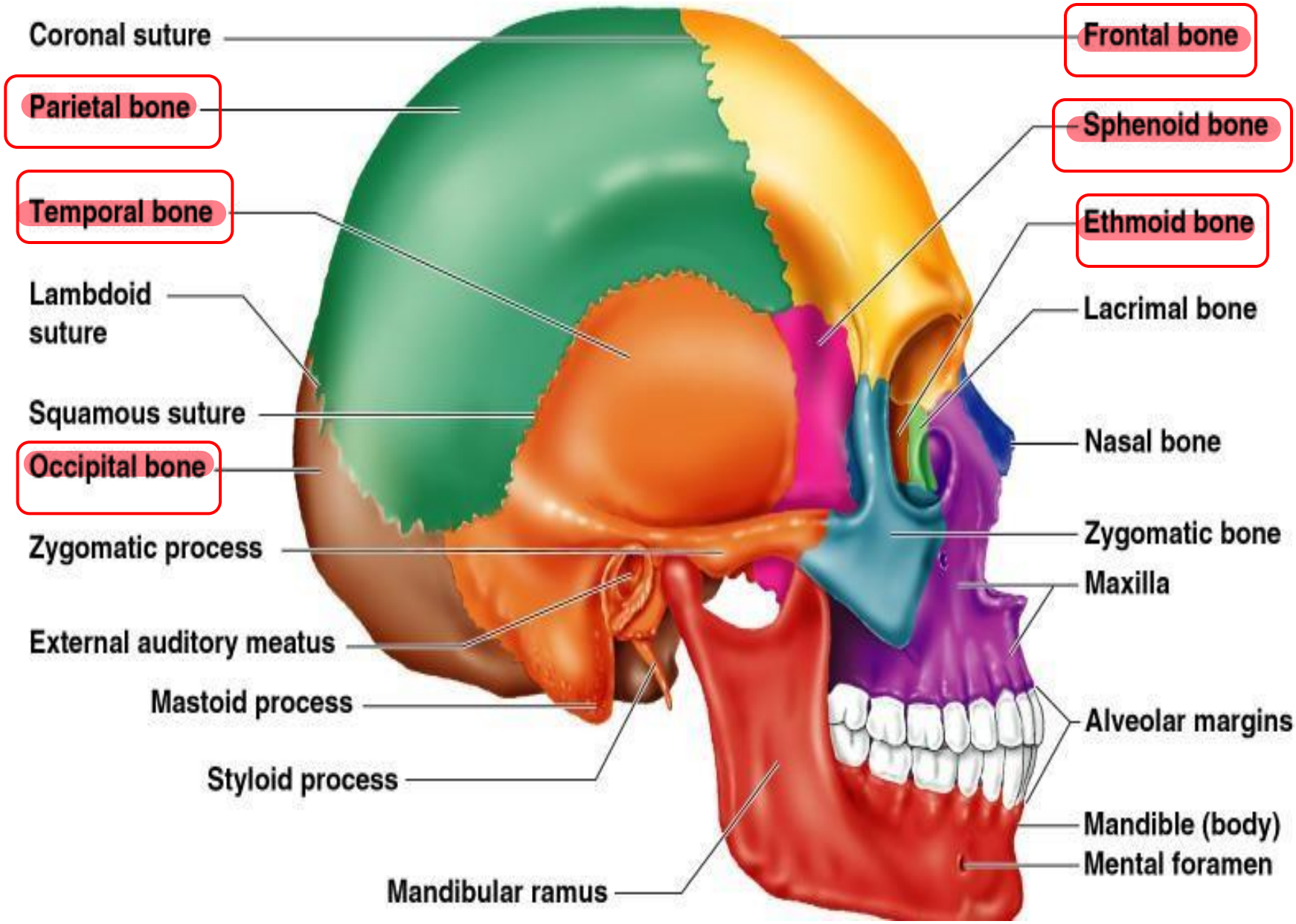
- Bones are joined by **sutures** زي لخياطة
- Only the mandible is attached by a freely **movable joint**

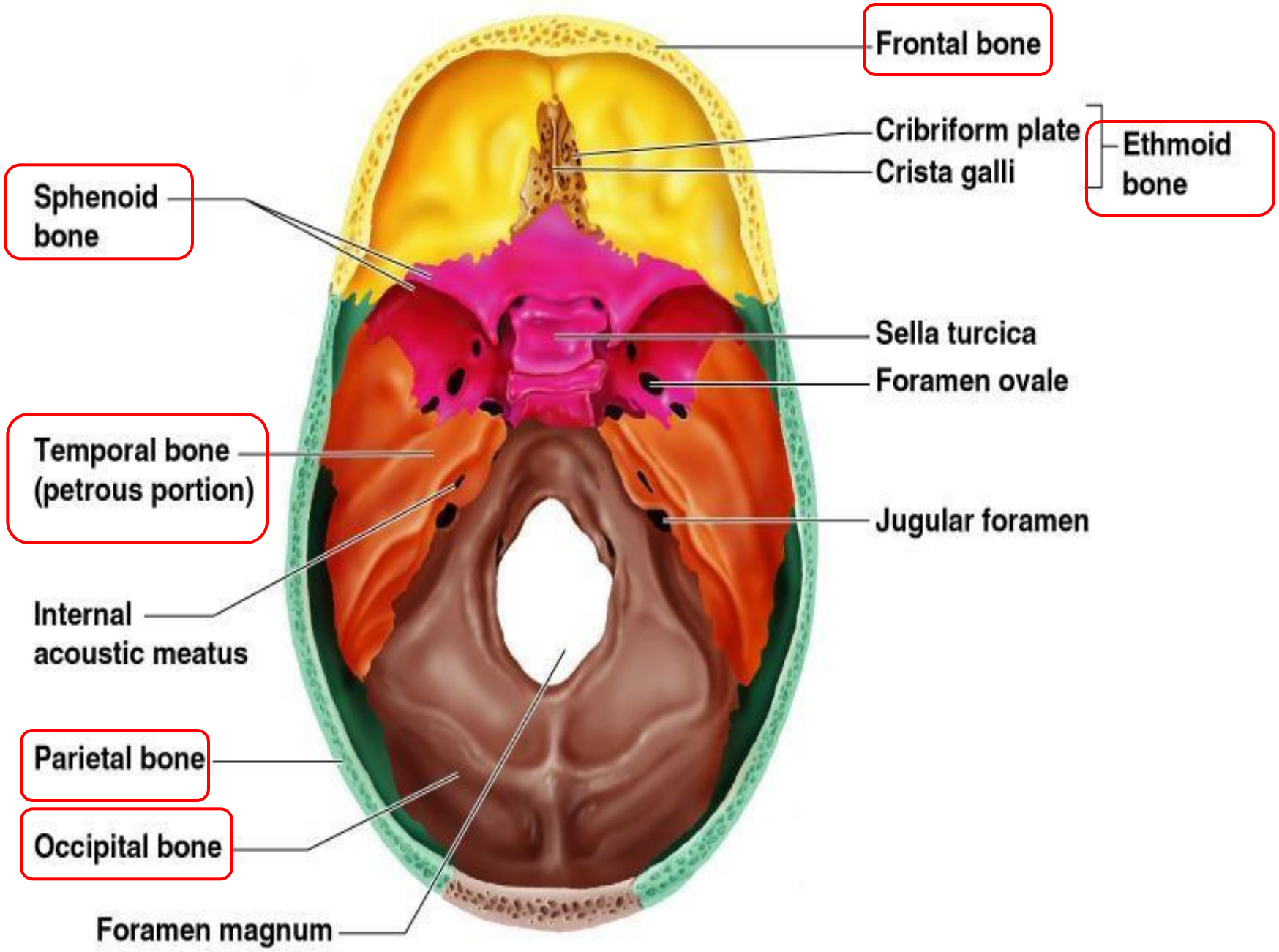
عظام الجمجمة

Cranial bones

1. Frontal bone (1) → عظم أمامي
2. Parietal bones (2) → جانبي
3. Temporal bones (2) → صدغي
4. Occipital one (1) → من الخلف
5. Sphenoid bone (1) → وتدي
6. Ethmoid bone (1) → عند الأنف



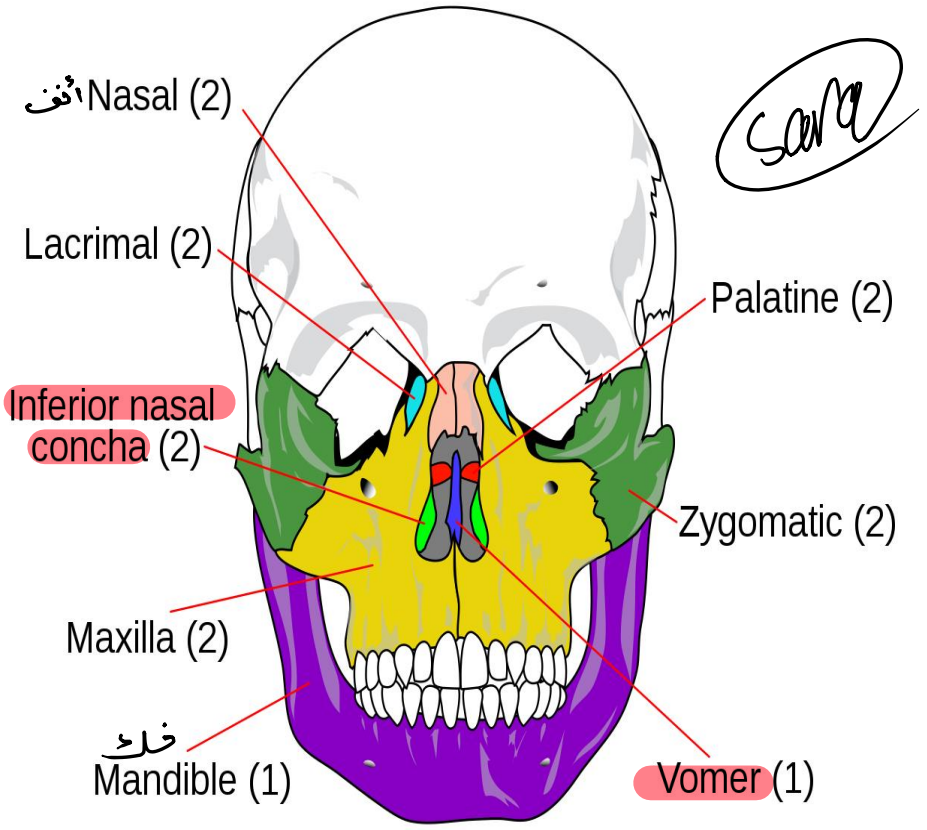

Coronal suture
Parietal bone
Temporal bone
Lambdoid suture
Squamous suture
Occipital bone
Zygomatic process
External auditory meatus
Mastoid process
Styloid process
Mandibular ramus
Frontal bone
Sphenoid bone
Ethmoid bone
Lacrimal bone
Nasal bone
Zygomatic bone
Maxilla
Alveolar margins
Mandible (body)
Mental foramen


Frontal bone
Cribriform plate
Crista galli
Ethmoid bone
Sphenoid bone
Sella turcica
Foramen ovale
Temporal bone (petrous portion)
Jugular foramen
Internal acoustic meatus
Parietal bone
Occipital bone
Foramen magnum

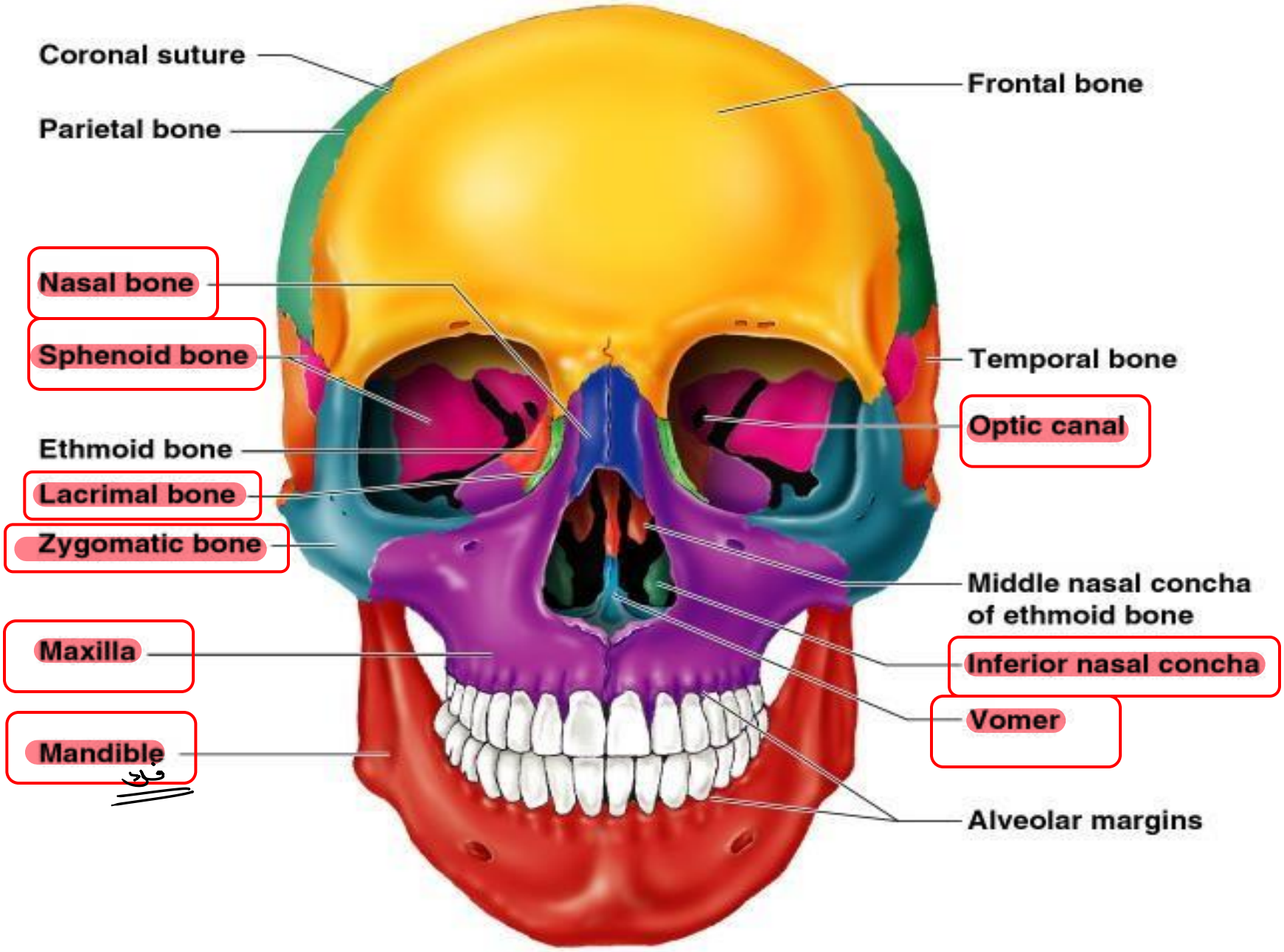
Facial bones

عظام الوجه

1. Nasal bones (2) → أنف ١٦
2. Lacrimal bones (2) → دمعي
3. Zygomatic bones (2) الخد
4. Inferior nasal conchae (2)
5. Maxillary bones (2) فك علوي
6. Platine bones (2) سقف الحلق
7. Mandible (1) فك سفلي
8. Vomer (1)



14 facial bones


Coronal suture
Parietal bone
Frontal bone
Nasal bone
Sphenoid bone
Temporal bone
Optic canal
Ethmoid bone
Lacrimal bone
Zygomatic bone
Middle nasal concha of ethmoid bone
Maxilla
Inferior nasal concha
Vomer
Mandible
Alveolar margins

Paranasal Sinuses

جيوب أنفية

7/8

Paranasal Sinuses

- ✓Hollow portions of bones surrounding the nasal cavity
- ✓Lighten the skull
- ✓Give resonance and amplification to voice

✓أجزاء مجوفة من العظام يحيط بتجويف الأنف

✓تفتيح الجمجمة

✓أعط صدى و تضخيم الصوت

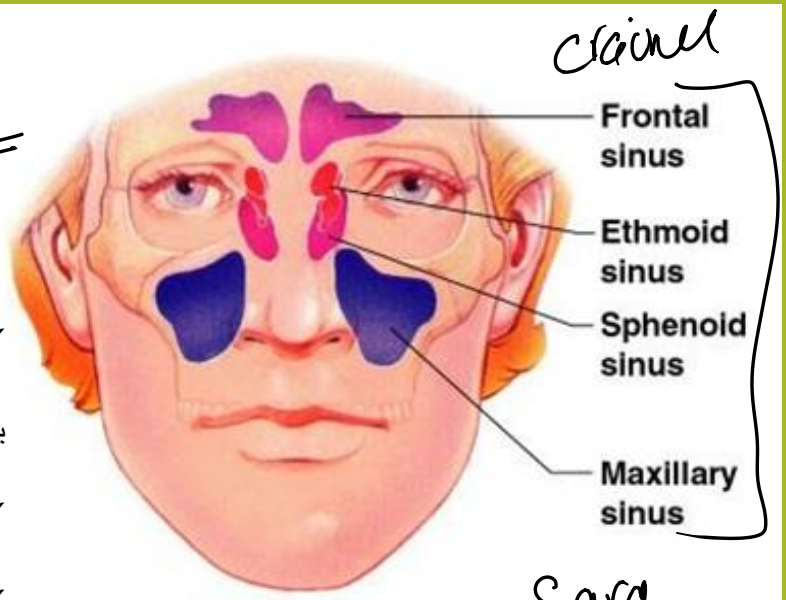
Hyoid bone

- ✓is the only bone that does not articulate with
- ✓another bone, & Serves as a moveable base for the tongue

✓هي العظمة الوحيدة التي لا التعبير مع

✓عظمة أخرى، وتعمل ك

قاعدة متحركة للسان



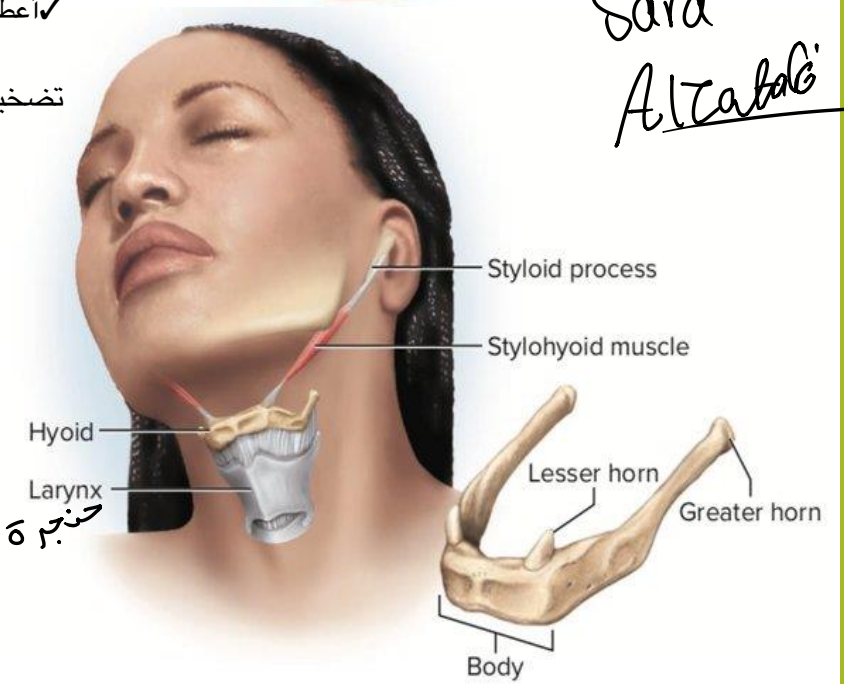


FIGURE 8.16 The Hyoid Bone.

Vertebral column

عمود الفقري

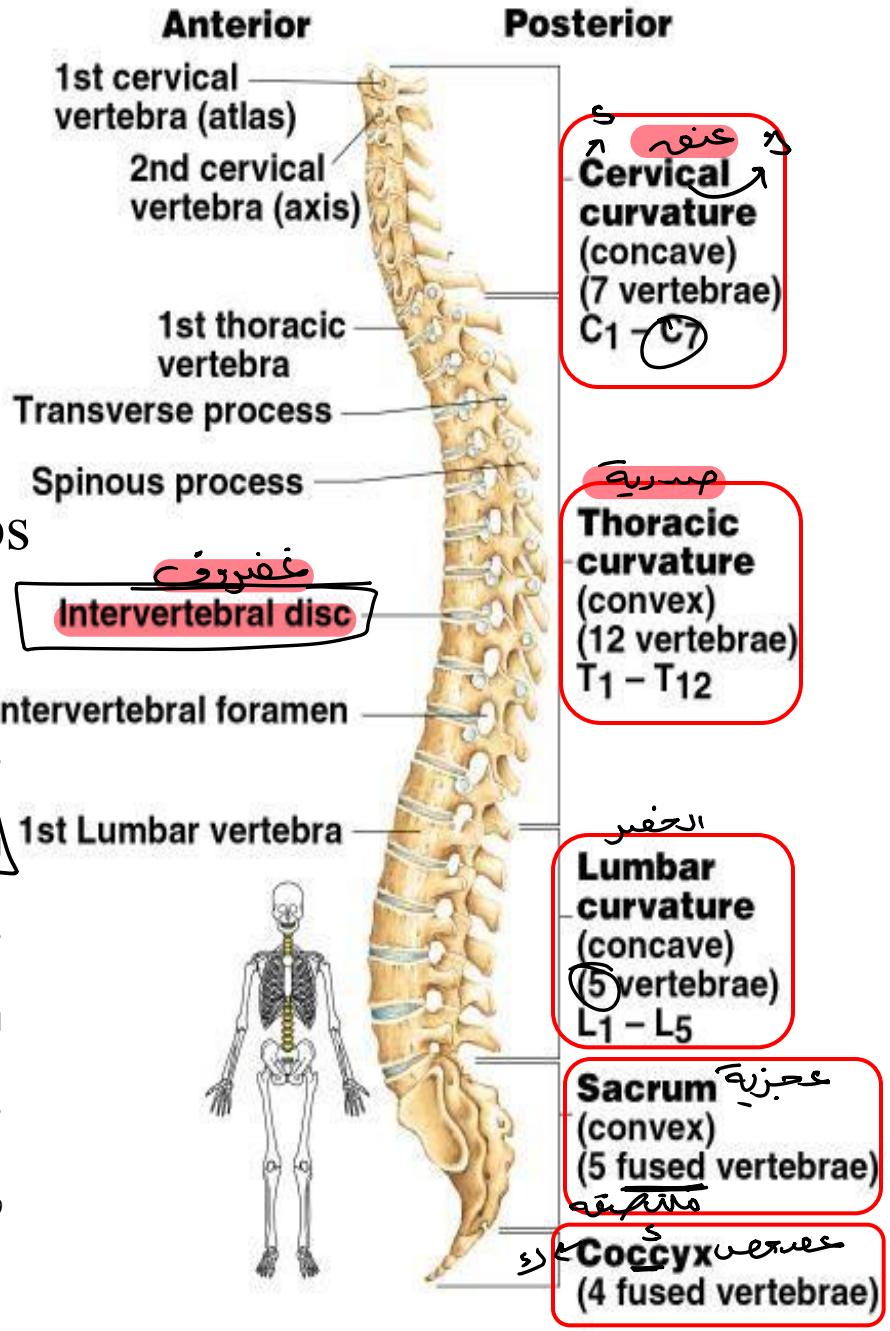
Functions:

1. Holds the head
2. Stiffens and supports the middle portion of the body
3. Provides attachment for the ribs and pelvic bone
4. Protects the spinal cord

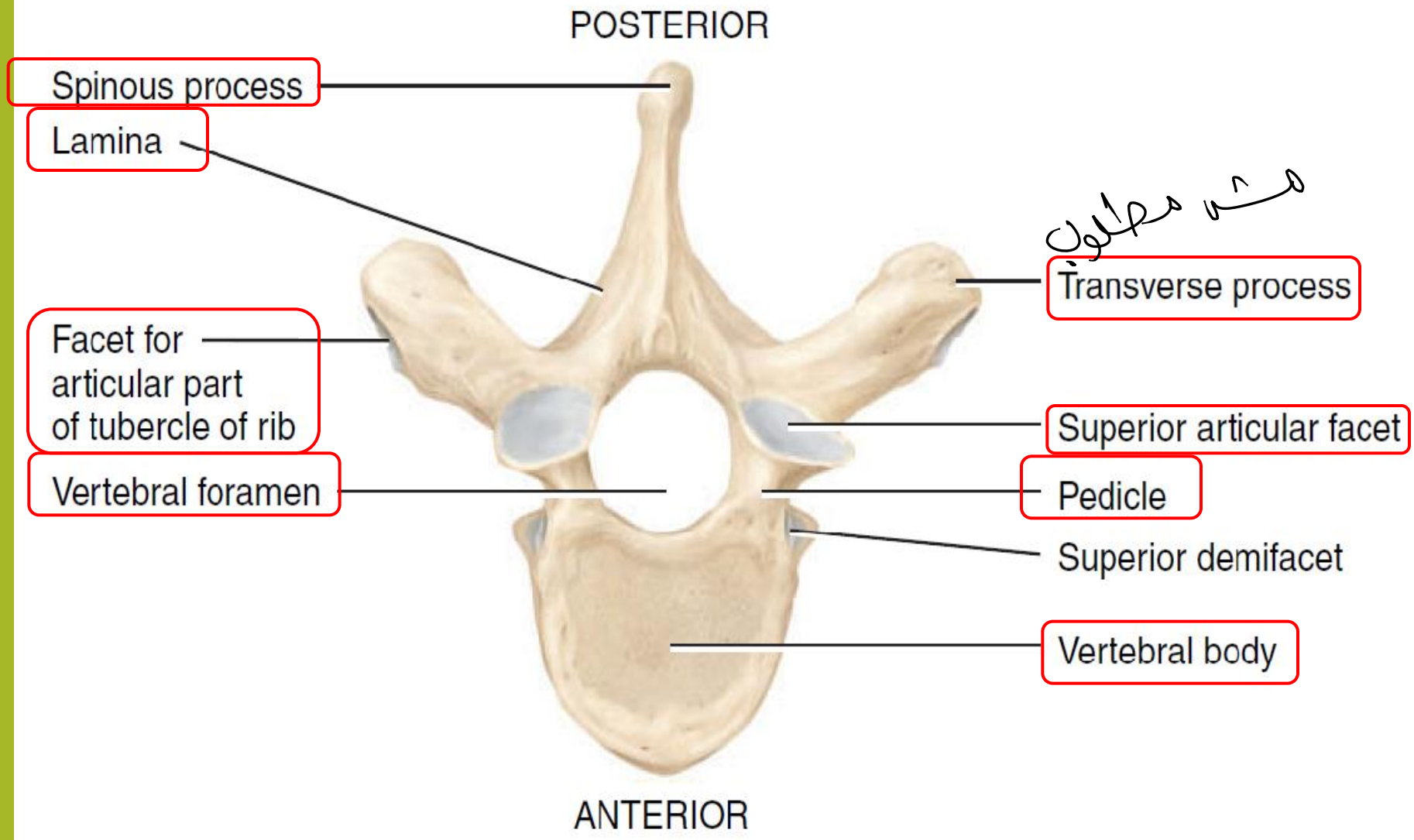
1. يحمل الرأس
2. يقوي ويدعم الجزء الأوسط من الجسم
3. يوفر مرفقا للأضلاع وعظام الحوض
4. يحمي الحبل الشوكي

- Vertebrae separated by **intervertebral discs**
- The spine has a **normal curvature**
- Each vertebra is given a name according to **its location**

- فقرات مفصولة عن طريق الأقراص الفقرية
- العمود الفقري طبيعي انحناء
- يتم إعطاء اسم لكل فقرة وفقا لموقعها

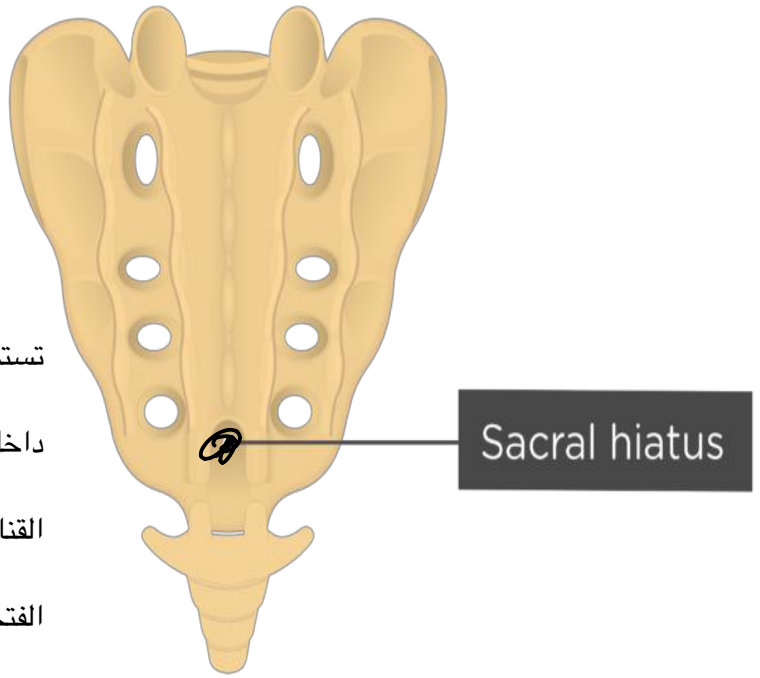


فقرات Vertebrae



SACRUM

- formed by the fusion of **five vertebrae.**
- The wing like alae articulate laterally with the **hip bones**, forming the **sacroiliac joints.**
- The vertebral canal continues inside the sacrum as the **sacral canal** and terminates in a large inferior opening called the **sacral hiatus**



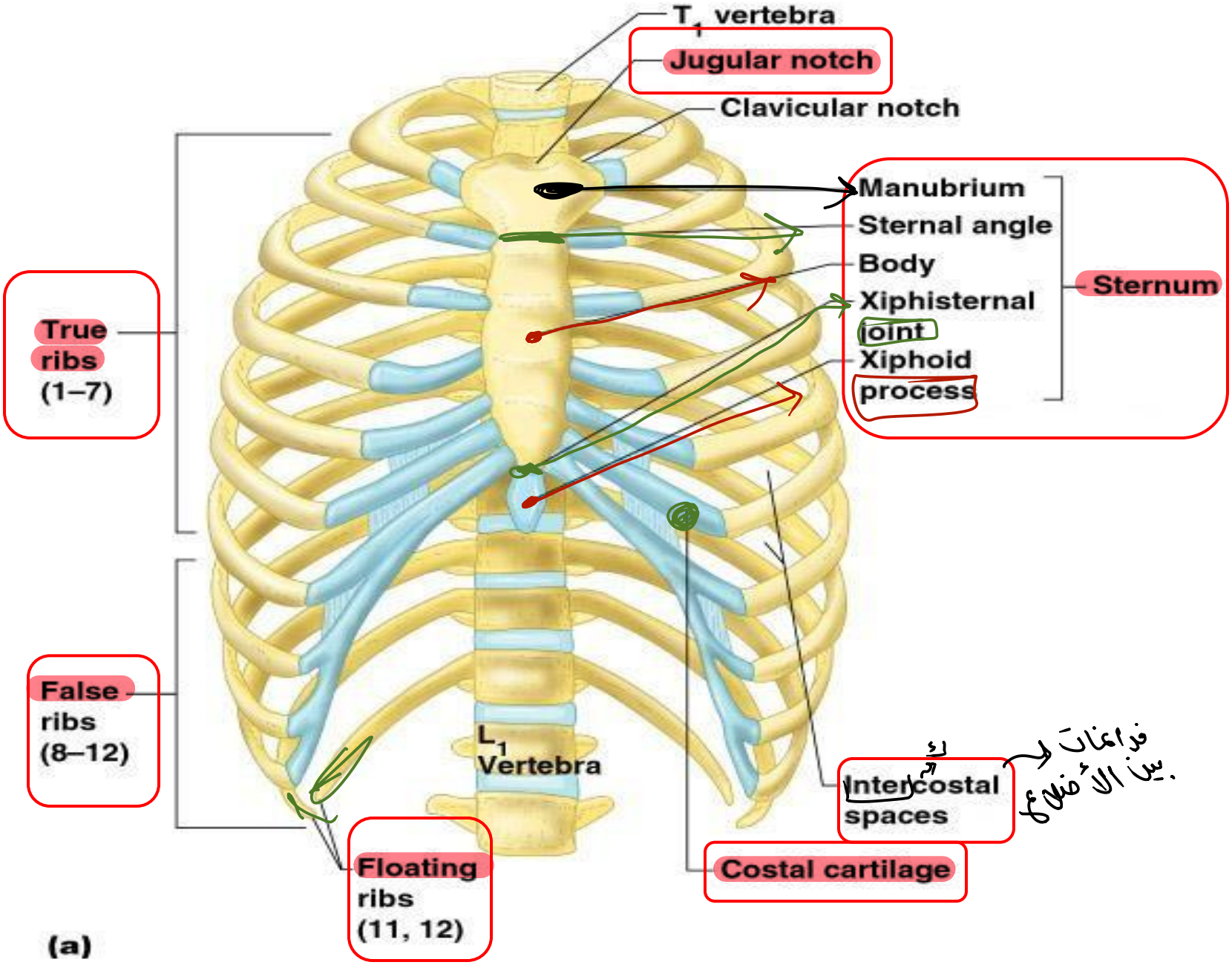
الصدر العظمي

The Bony Thorax

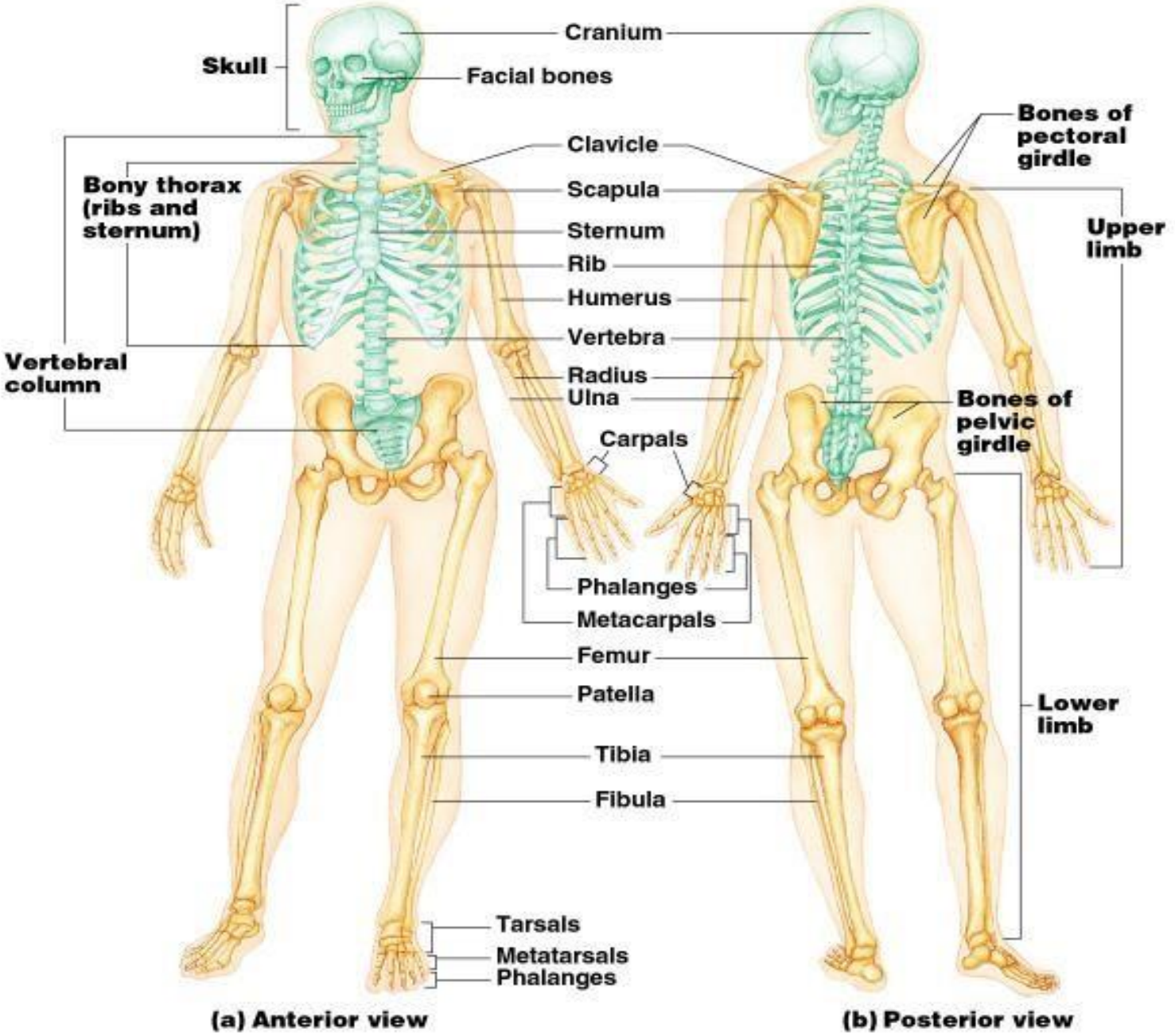
Made up of three parts:

1. Sternum → عظمة القص
2. Ribs → أضلاع
3. Thoracic vertebrae → فقرات صدرية

- Forms a cage to protect major organ


T_1 vertebra
Jugular notch
Clavicular notch
Manubrium
Sternal angle
Body
Xiphisternal joint
Xiphoid process
Sternum
True ribs (1–7)
False ribs (8–12)
L_1 Vertebra
Intercostal spaces
Costal cartilage
Floating ribs (11, 12)
(a)

The Appendicular Skeleton



حزام الصدر (الكتف)

The Pectoral (Shoulder) Girdle

Composed of two bones

1. Clavicle → الترقوة
2. Scapula → لوح الكتف

- The shoulder girdle is very light (خفيف) and allows the upper limb to have free movement

يعلق كل حزام كتف بالهيكل العظمي المحوري في نقطة واحدة فقط (المفصل القصي الترقوي)

- Each shoulder girdle attaches to the axial skeleton at only one point (sternoclavicular joint)

المفصل القصي الترقوي

التجويف الحقاني ضحل، ومفصل الكتف يتم تعزيزه بشكل سيئ بواسطة الأربطة

- The glenoid cavity is shallow, and the shoulder joint is poorly reinforced by ligaments → الأربطة

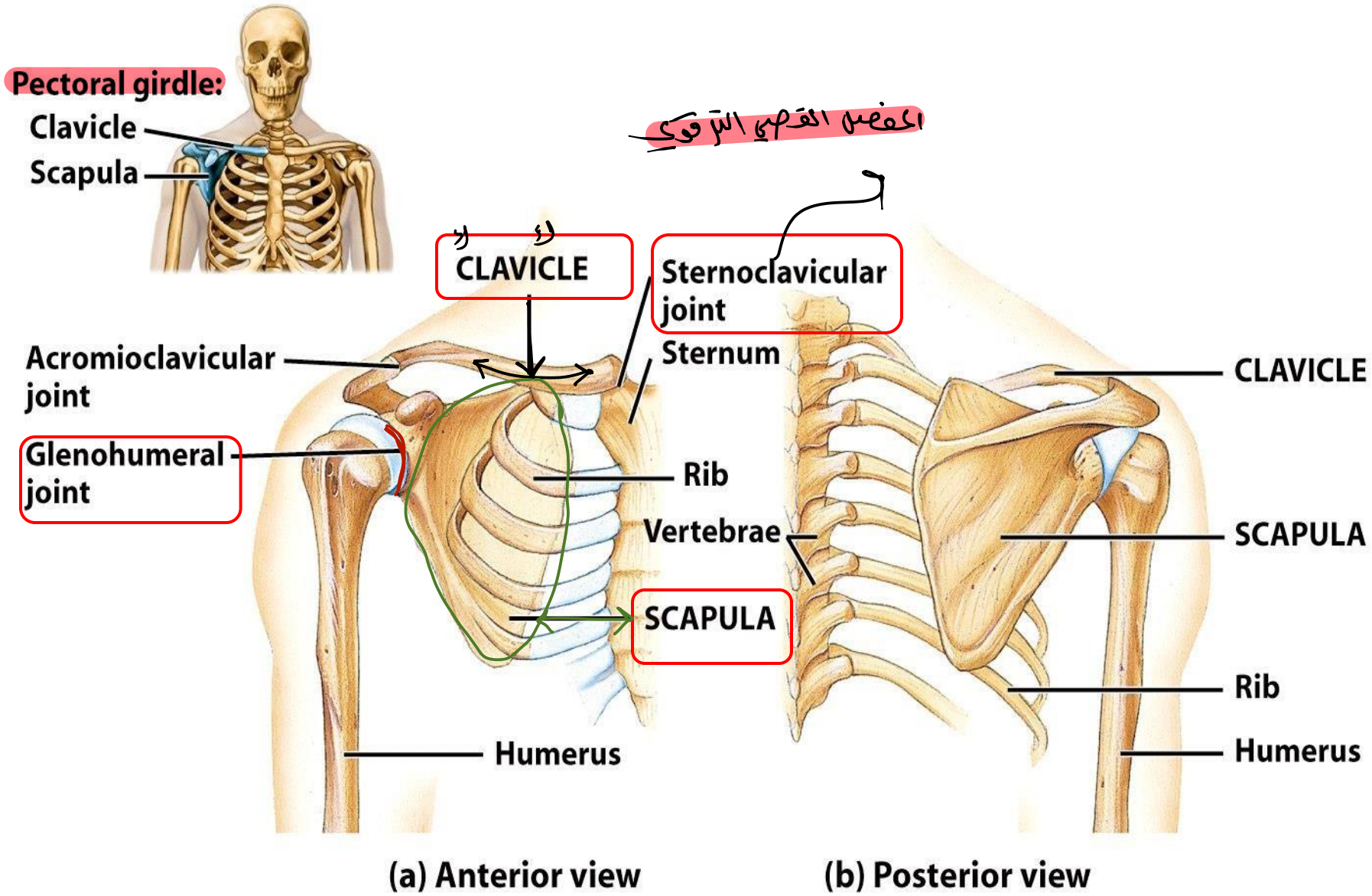


Figure 8-1 Principles of Anatomy and Physiology, 11/e

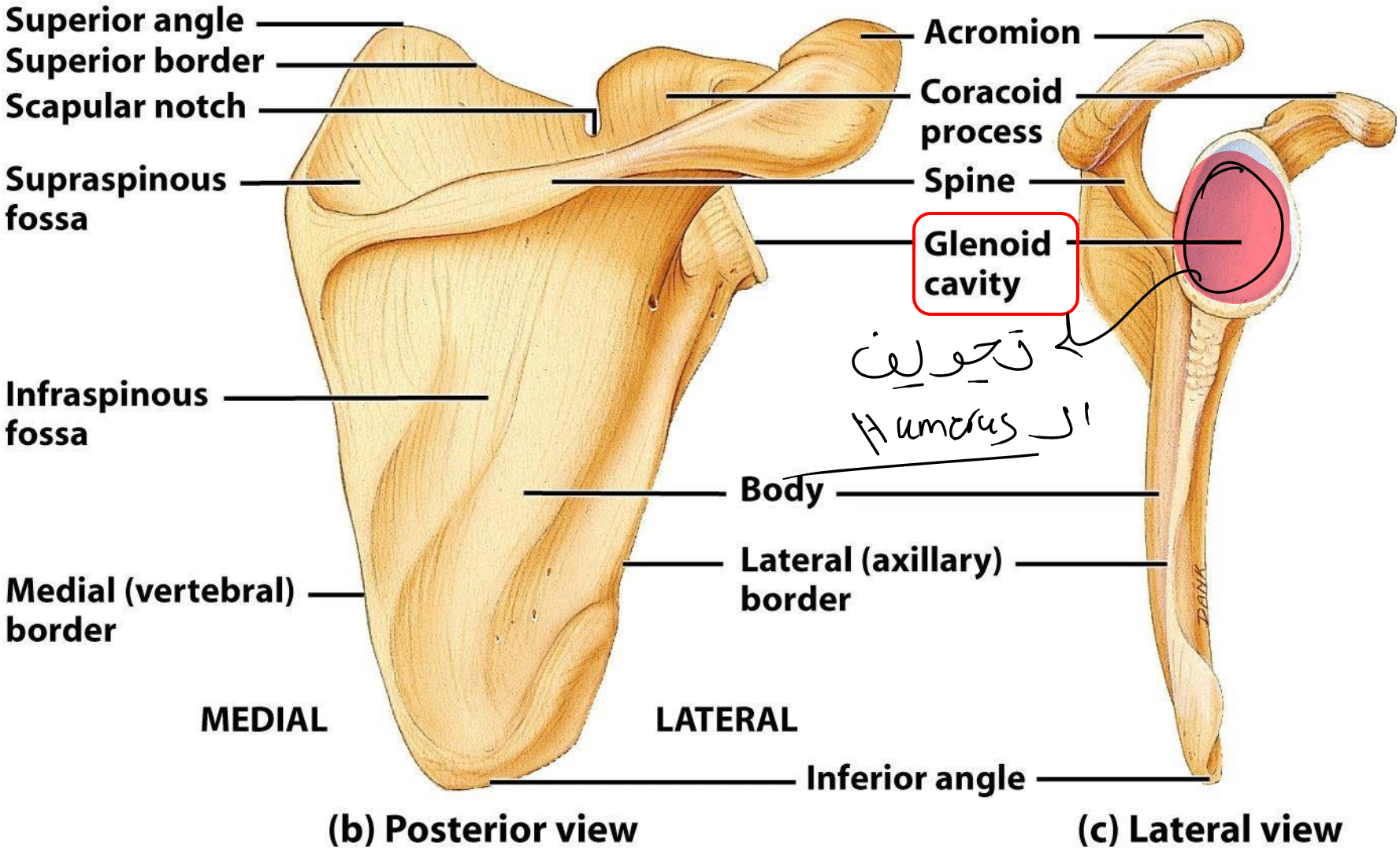
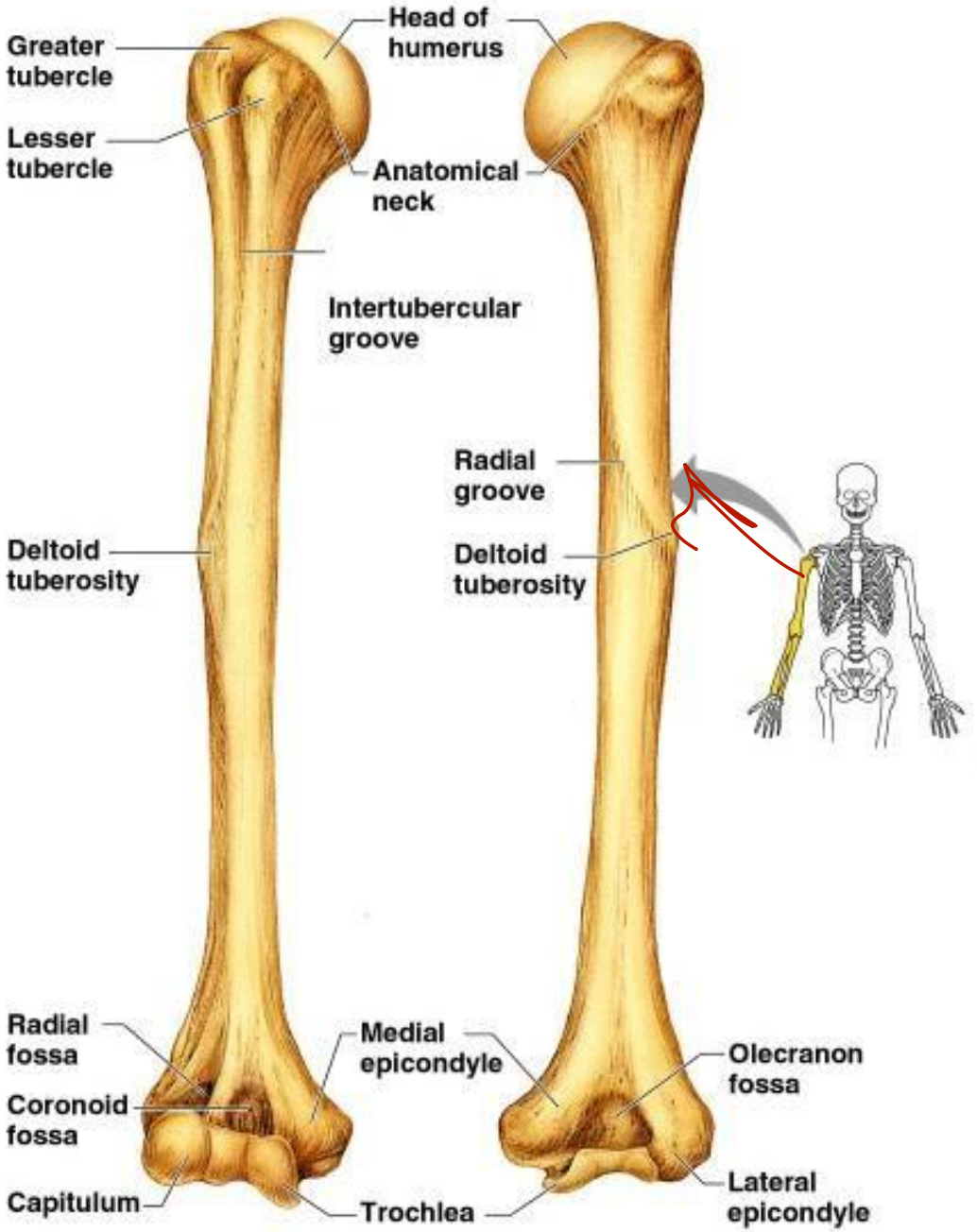


Figure 8-3bc Principles of Anatomy and Physiology, 11/e

Bones of the Upper Limb

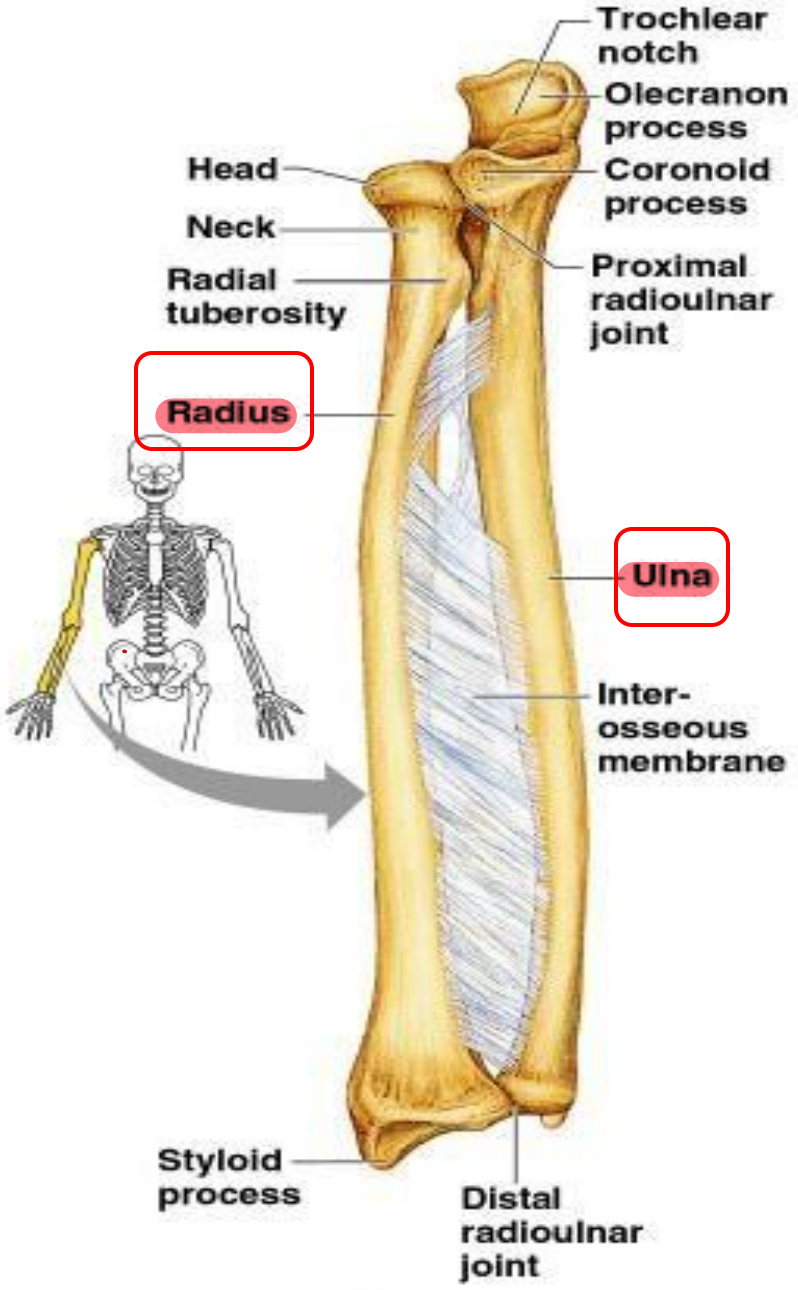
The arm is formed by a single bone (**Humerus**)

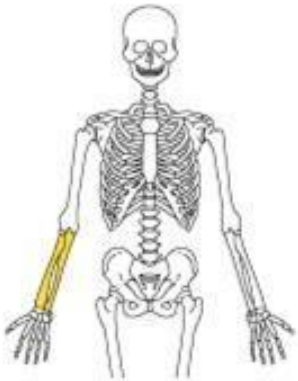


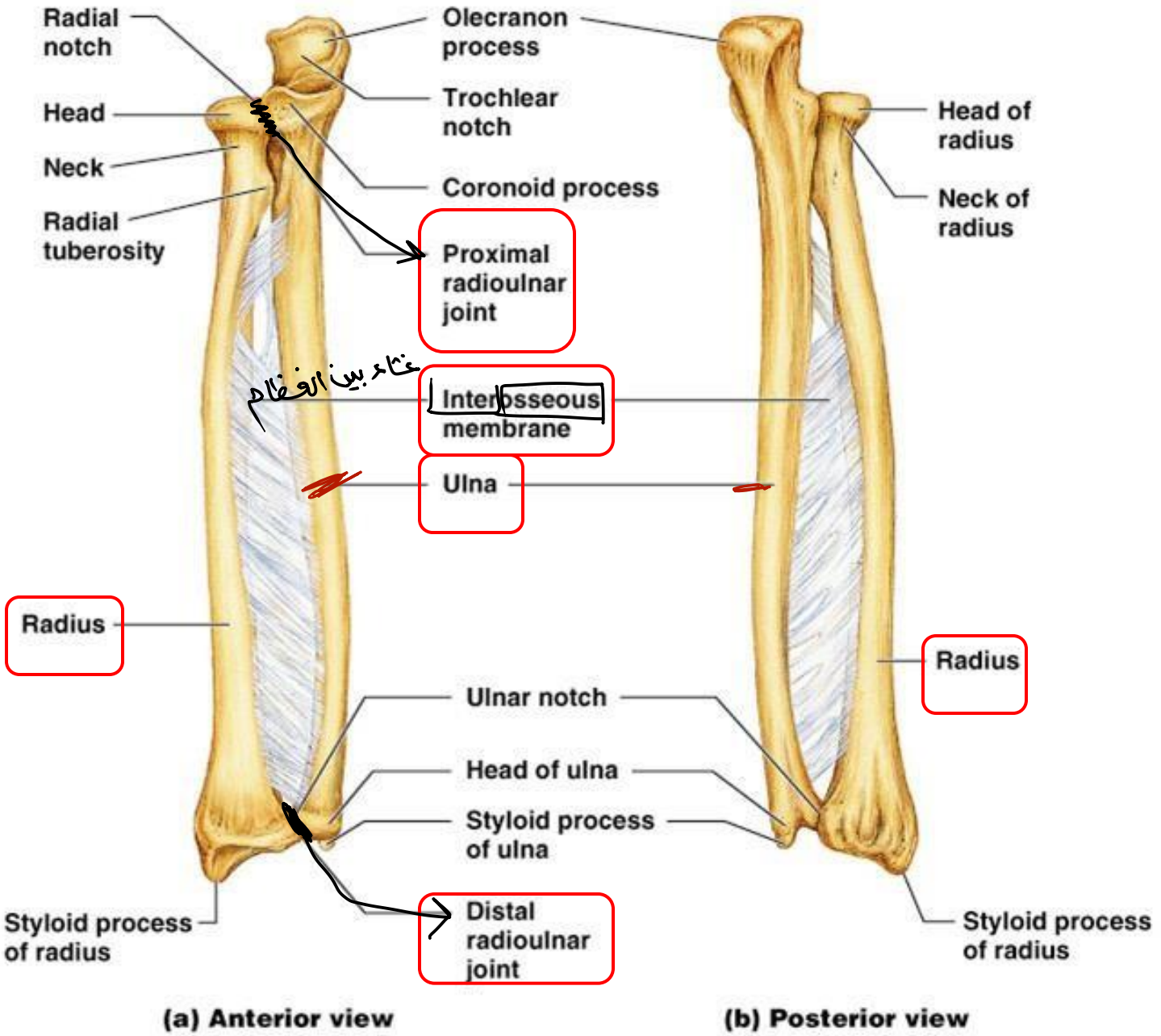
Bones of the Upper Limb

The forearm has two bones

1. Ulna
2. Radius







Bones of the Upper Limb

- **The hand**

الرسغ - المعصم

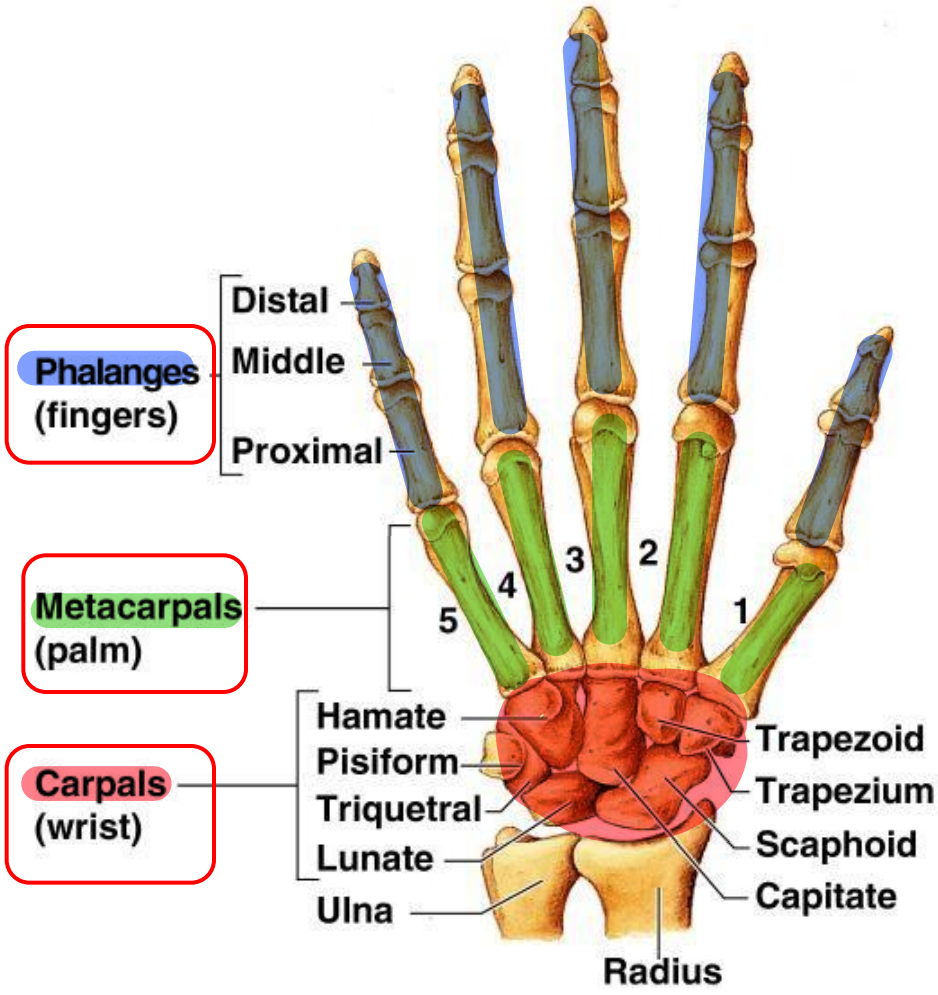
- **Carpals** – wrist

مشط القدم - النخيل

- **Metacarpals** – palm

- **Phalanges** – fingers

اصابع



حزام الحوض يتكون من عظام الورك والعجز و

عصعص

Bones of the Pelvic Girdle

- **Pelvic Girdle** Composed of the **hipbones, sacrum and coccyx**

Hip bones

Composed of three pairs of fused bones:

1. Ilium 1. الحرقفي
2. Ischium 2. إسكيوم
3. Pubic bone 3. عظم العانة

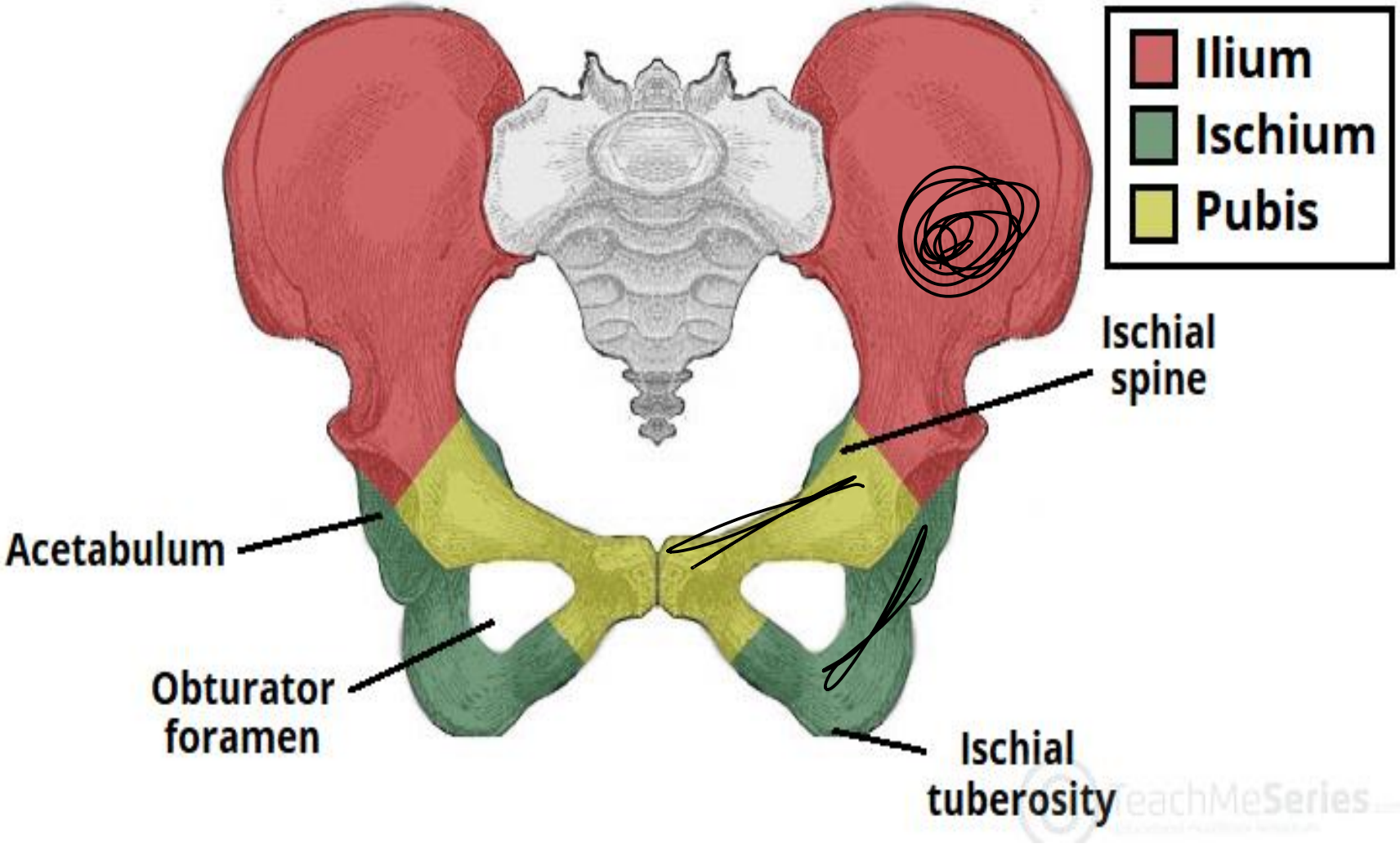
يقع الوزن الإجمالي للجزء العلوي من الجسم على الحوض

يحمي الأعضاء التناسلية والمثانة البولية و

جزء من الأمعاء الغليظة

Function:

1. The total weight of the upper body rests on the pelvis
2. Protects the reproductive organs, urinary bladder and part of the large intestine


Ilium
Ischium
Pubis
Ischial spine
Acetabulum
Obturator foramen
Ischial tuberosity

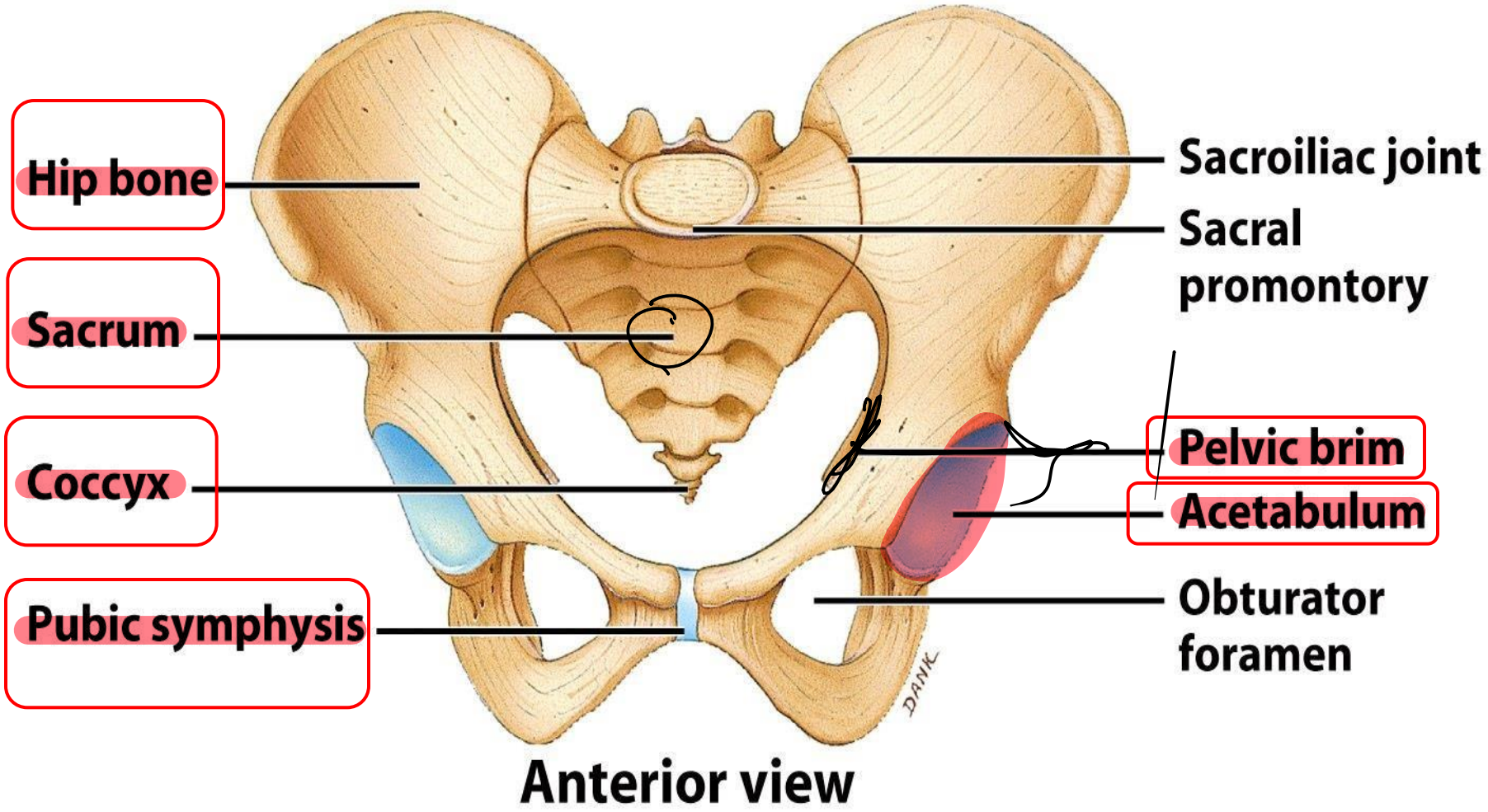


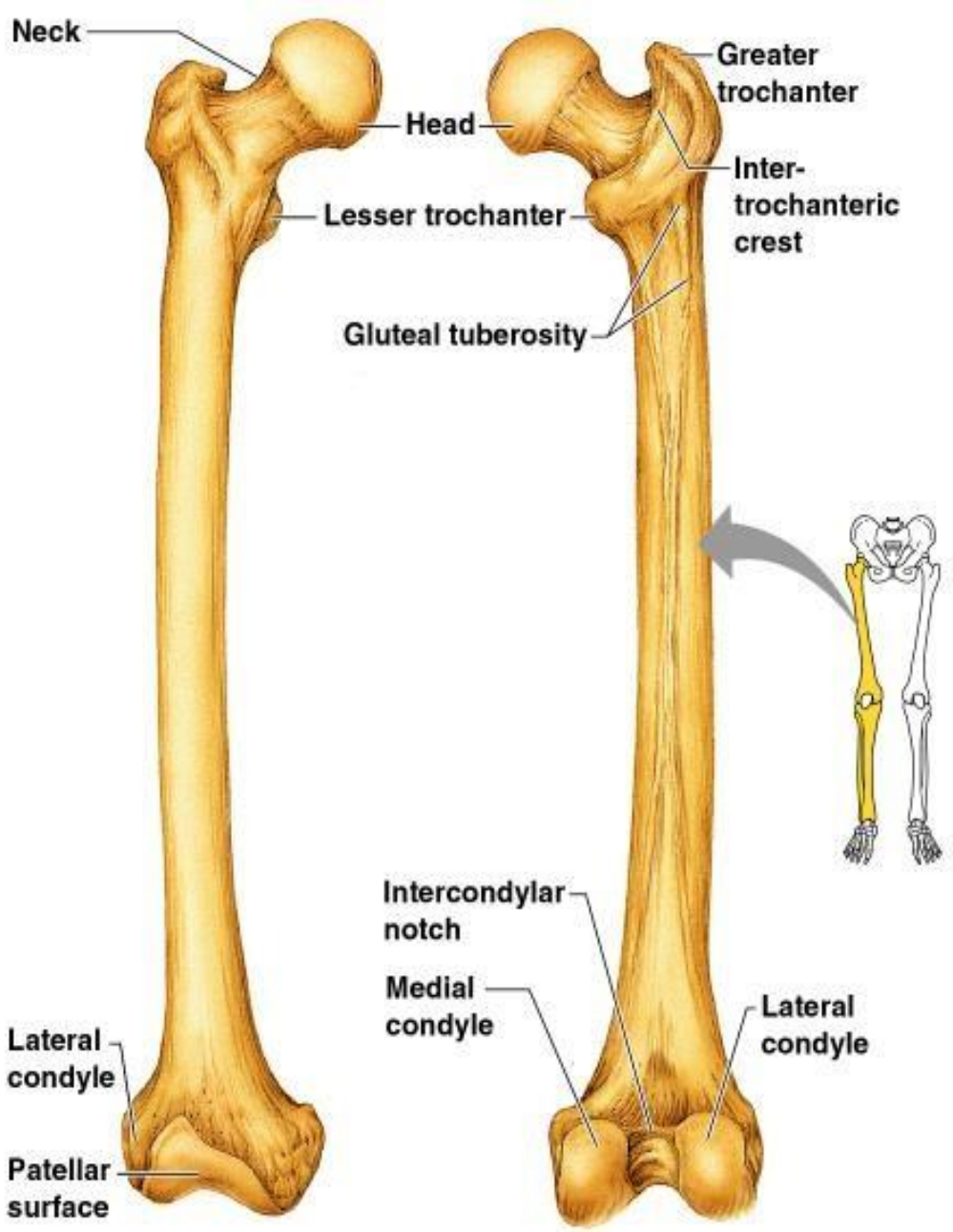
Figure 8-9 part 2 Principles of Anatomy and Physiology, 11/e

Ilium, ischium, and pubis fuse at the deep socket called the **Acetabulum** which receives the head of the thigh bone

Bones of the Lower Limbs

The thigh has one bone: فخذ

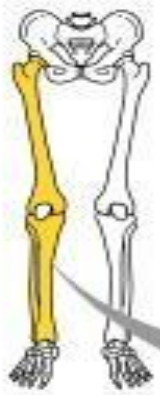
Femur (thigh bone)

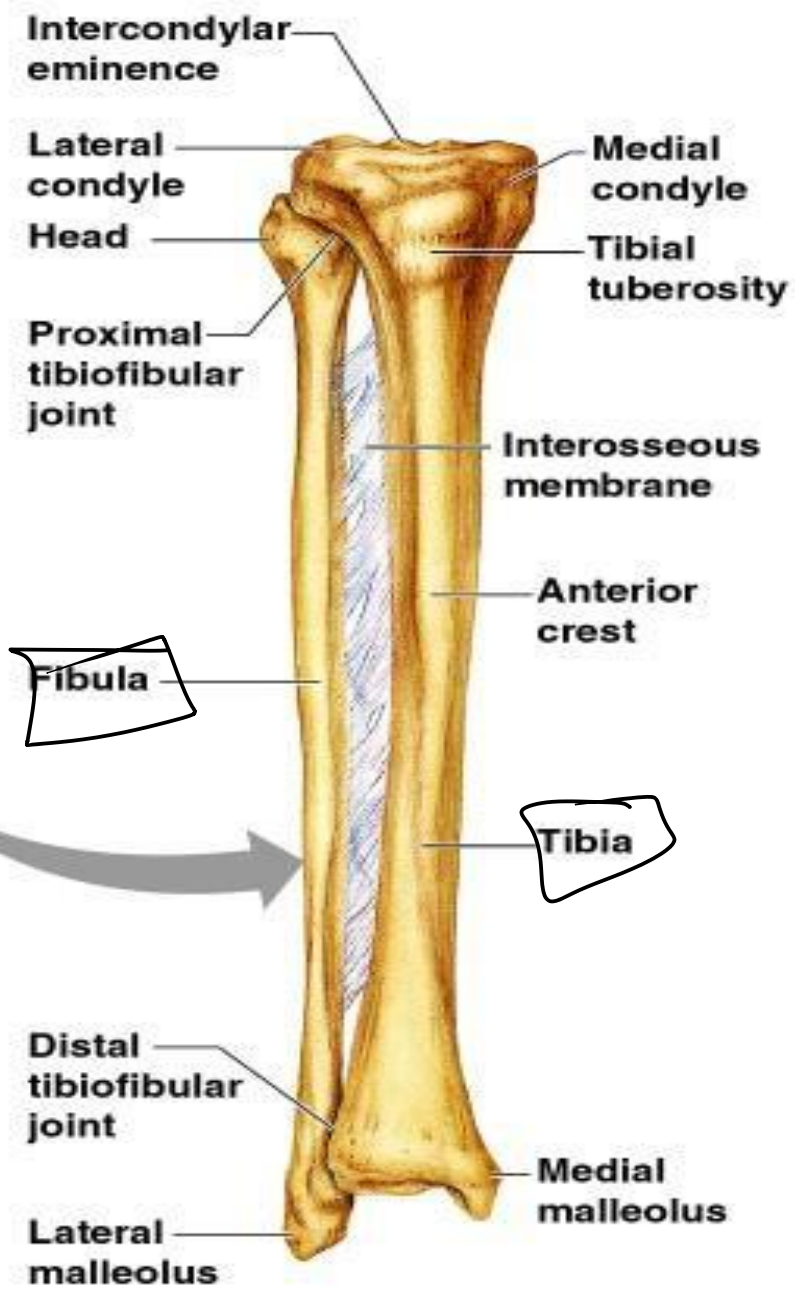


Bones of the Lower Limbs

The leg has two bones:

1. Tibia → ساق
2. Fibula → شظية

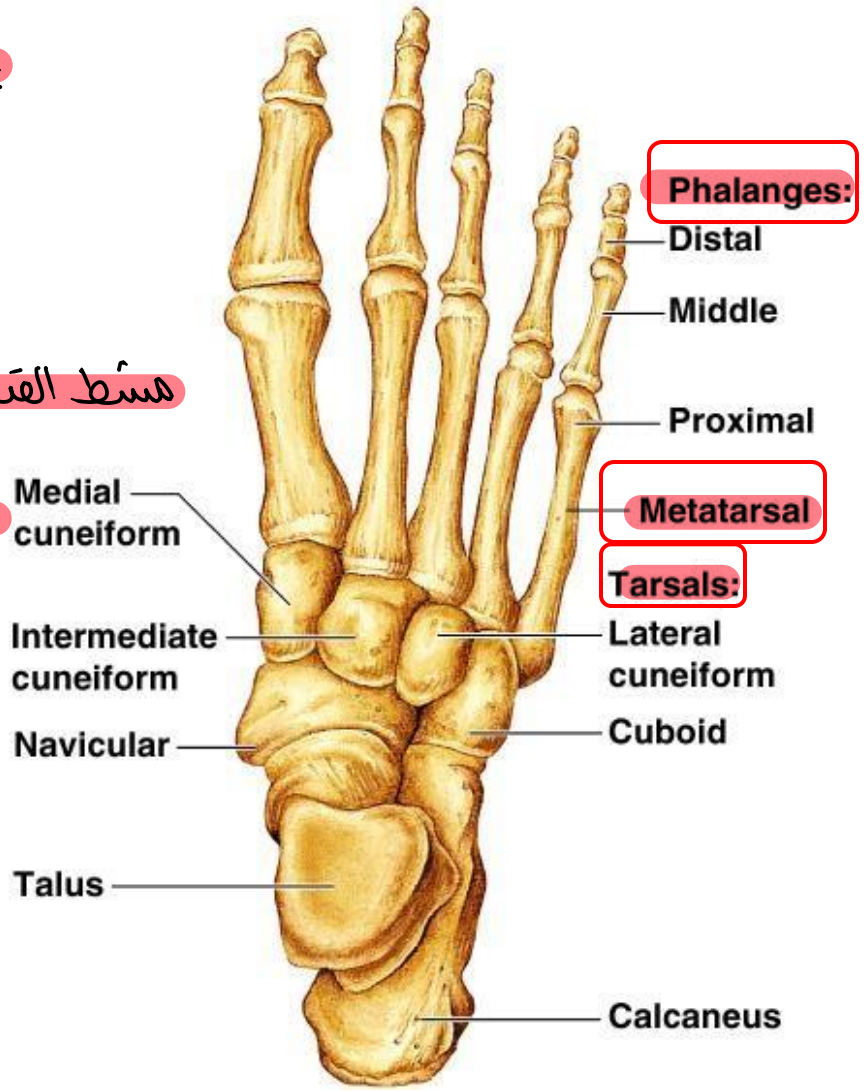




Foot

1. Tarsus (ankle) → كاحل
2. Has seven tarsal 7 bones
3. Metatarsals (sole) → مشط القدم
4. Phalanges (toes) → أصابع

- All toes have three phalanges except the hallux (two phalanges)



مفاصل Joints

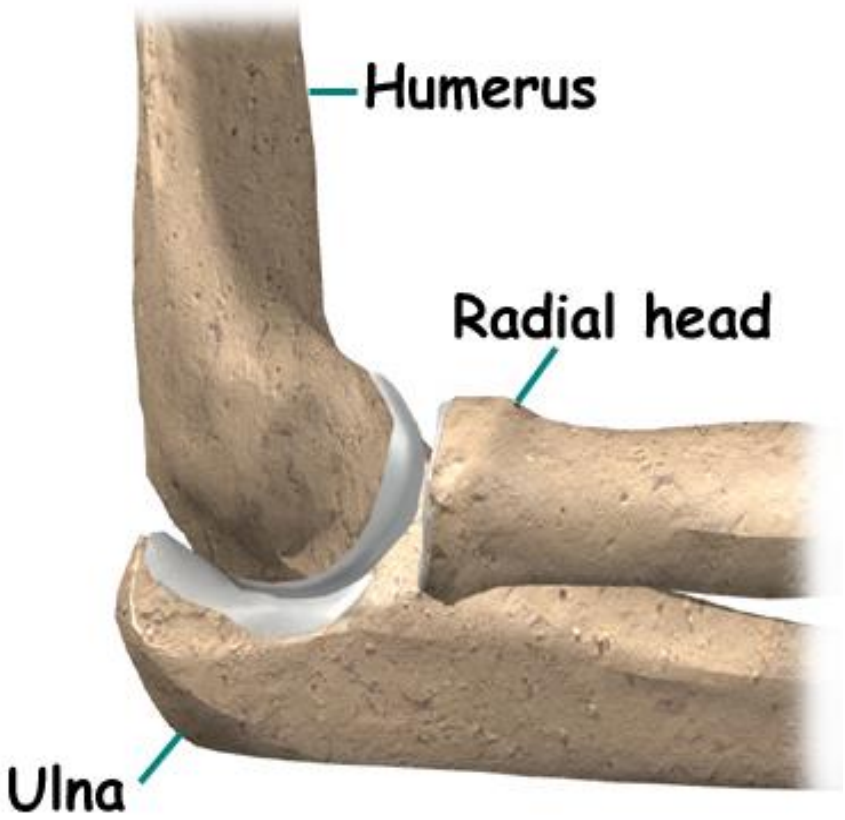
- Articulations of bones

Functions of joints:

1. Hold bones together
2. Allow for mobility

Joints are classified:

1. Functionally
2. Structurally



Classifications of Joints

Functional Classification of Joints:

1. **Synarthroses:** Immovable joints
2. **Amphiarthroses:** Slightly moveable joints
3. **Diarthroses:** Freely moveable joints

Structural Classification of Joints:

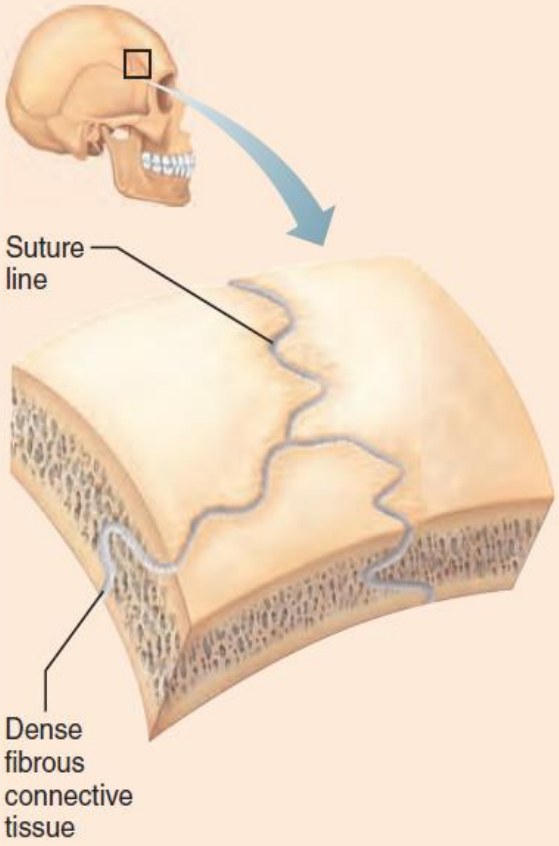
1. **Fibrous joints**: Generally immovable
2. **Cartilaginous joints**: Immovable or slightly moveable
3. **Synovial joints**: Freely moveable

Fibrous Joints

تربط عظام الجمجمة

(a) Suture

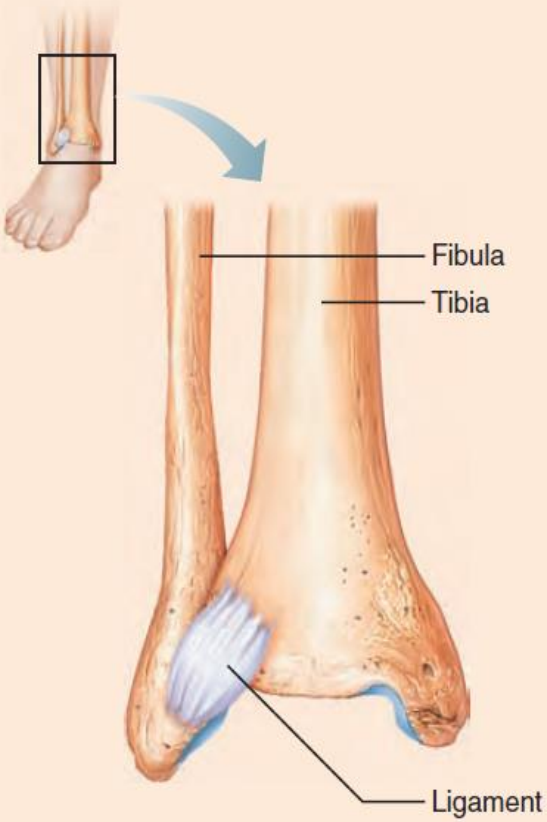
Joint held together with very short, interconnecting fibers, and bone edges interlock. Found only in the skull.



ازجة ضامة تربطهم مع بعض

(b) Syndesmosis

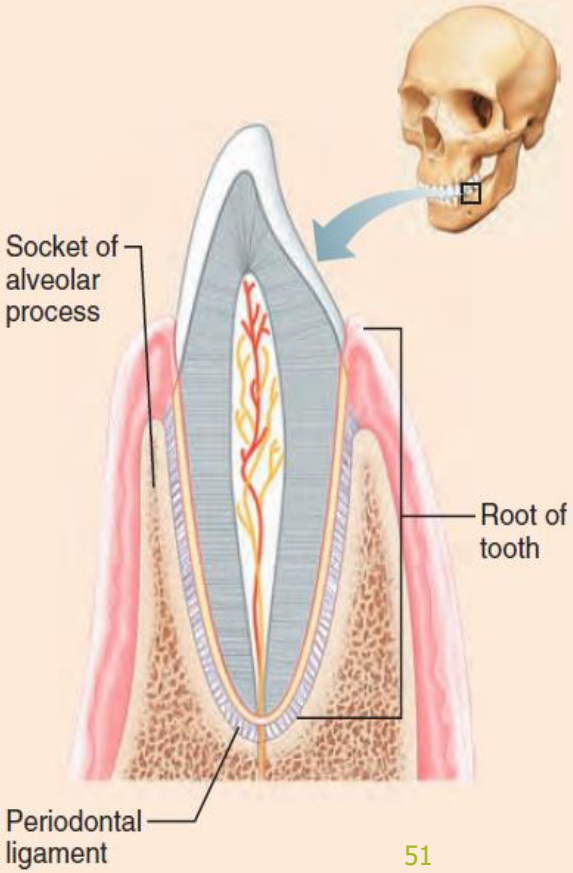
Joint held together by a ligament. Fibrous tissue can vary in length, but is longer than in sutures.



تربط الأسنان بالعظم

(c) Gomphosis

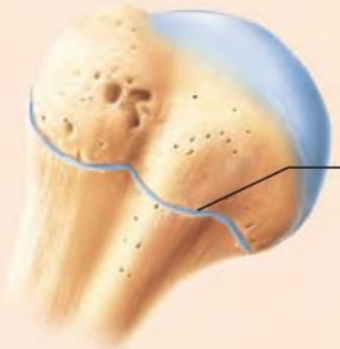
"Peg in socket" fibrous joint. Periodontal ligament holds tooth in socket.



Cartilaginous Joints

(a) Synchondroses

Bones united by hyaline cartilage



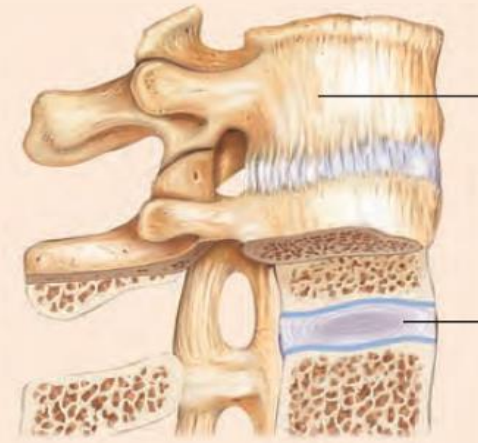
Epiphyseal plate (temporary hyaline cartilage joint)

Sternum (manubrium)

Joint between first rib and sternum (immovable)

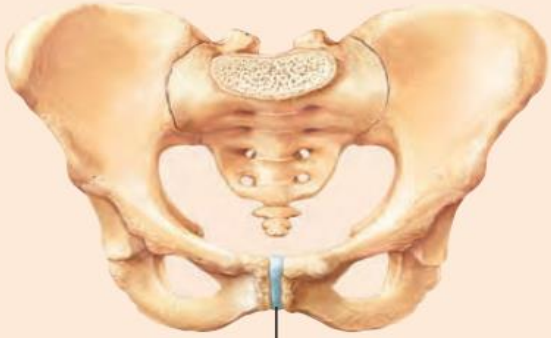
(b) Symphyses

Bones united by fibrocartilage



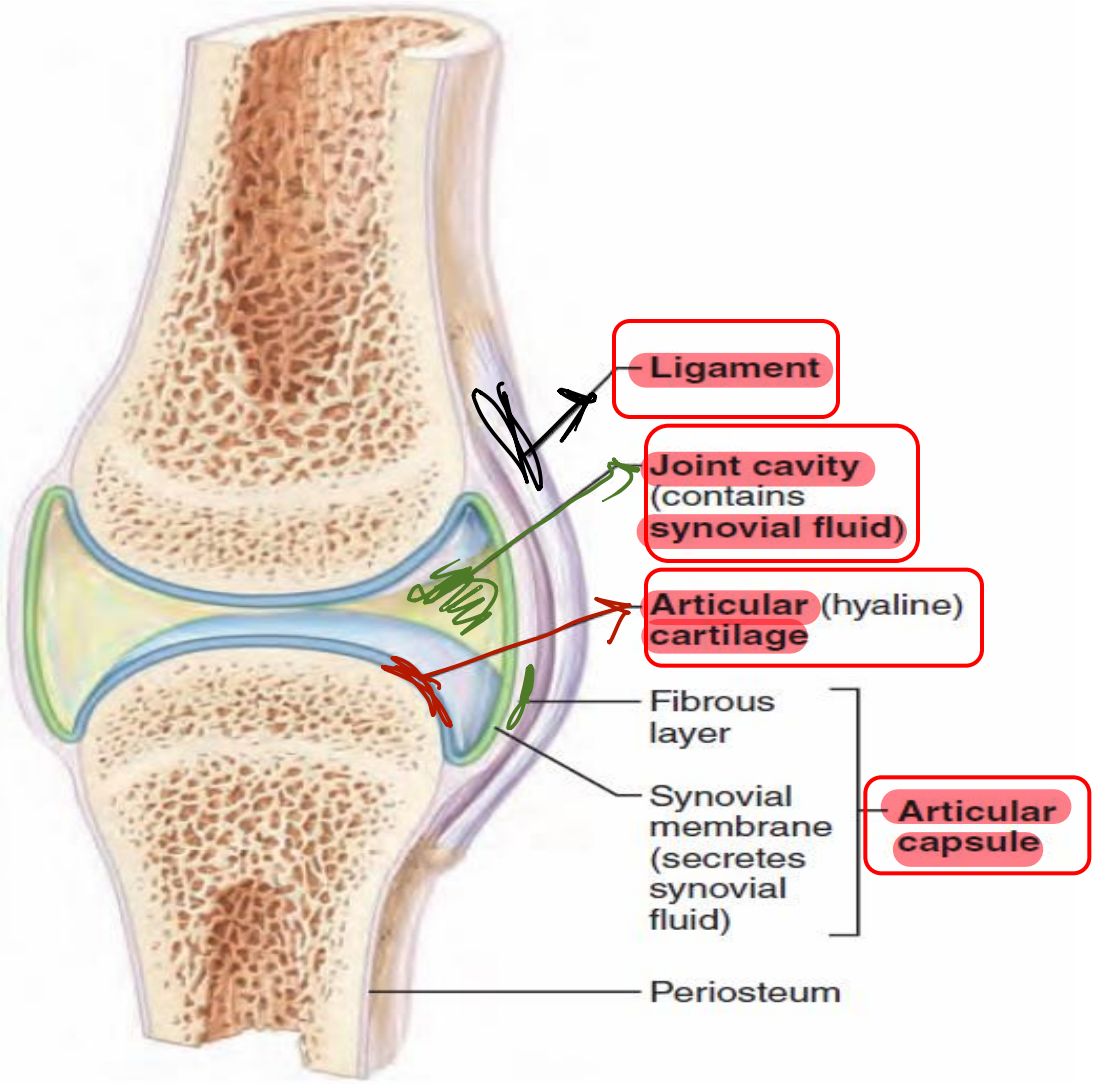
Body of vertebra

Fibrocartilaginous intervertebral disc (sandwiched between hyaline cartilage)



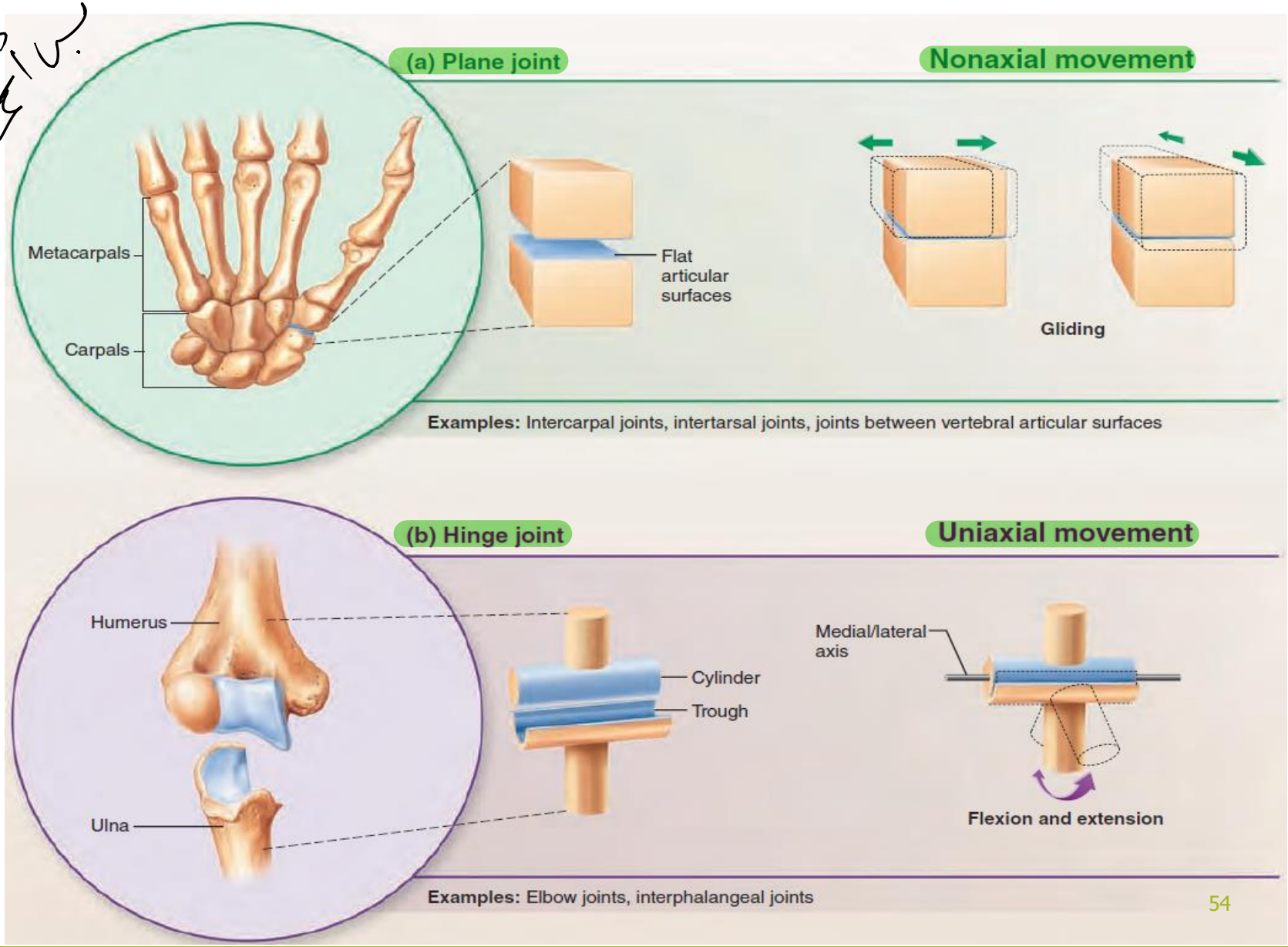
Pubic symphysis

Synovial Joints

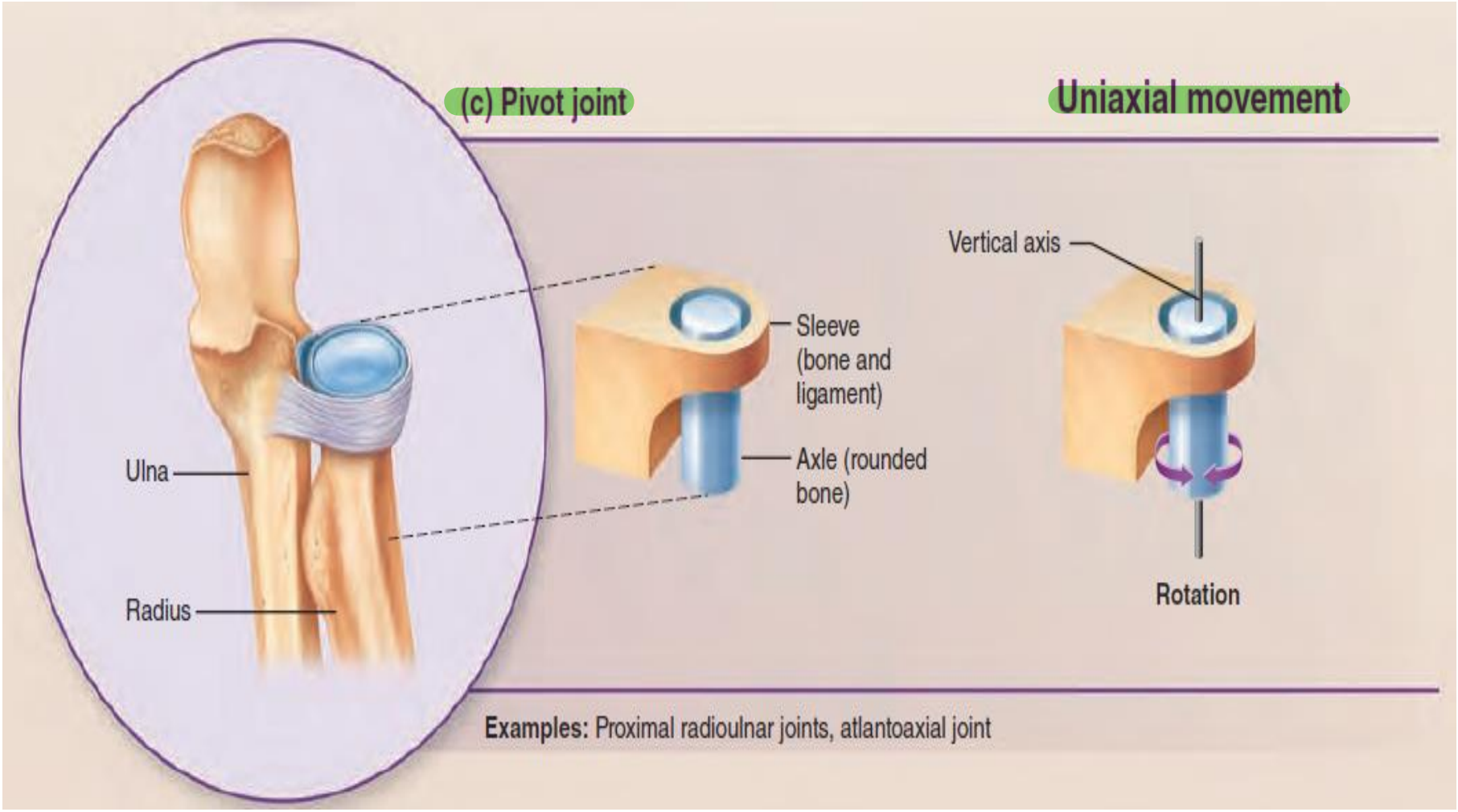


أنواع المفاصل الزليلية بناء على الشكل

Types of Synovial Joints Based on Shape



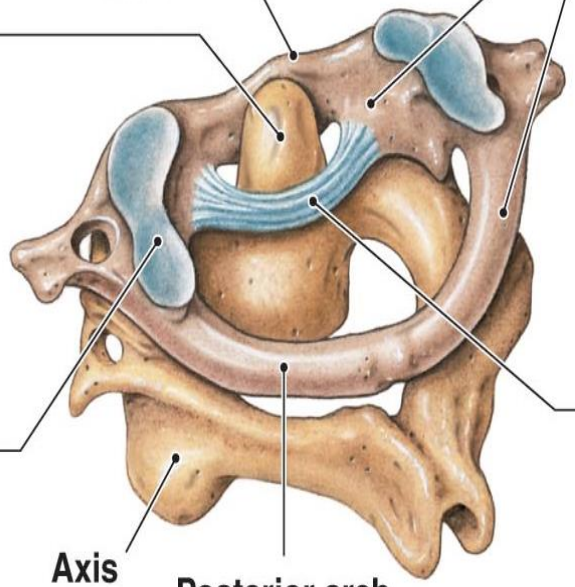
Types of Synovial Joints Based on Shape



المفاصل المحورية

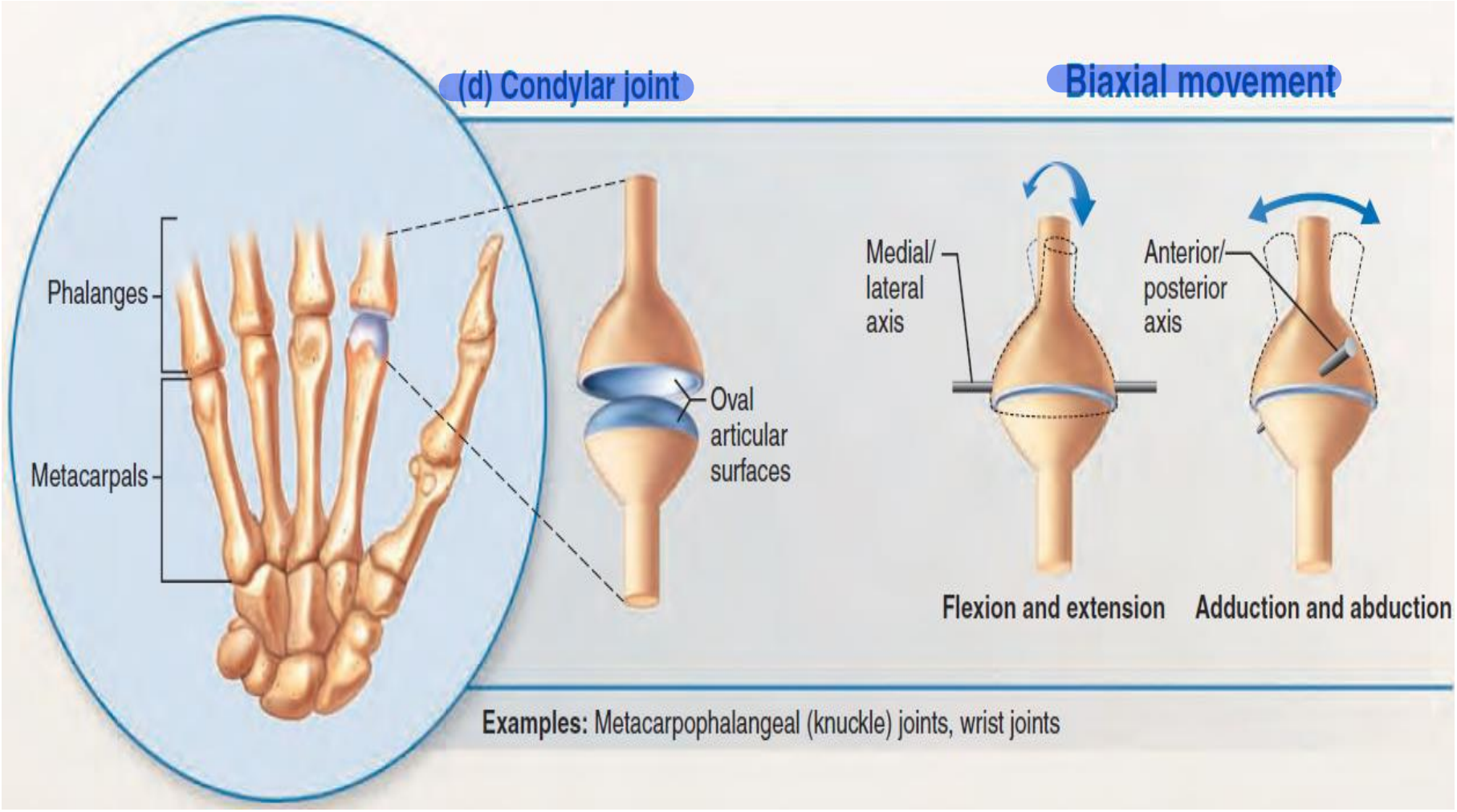
Pivot joints

The first two cervical vertebrae: the atlas and the axis

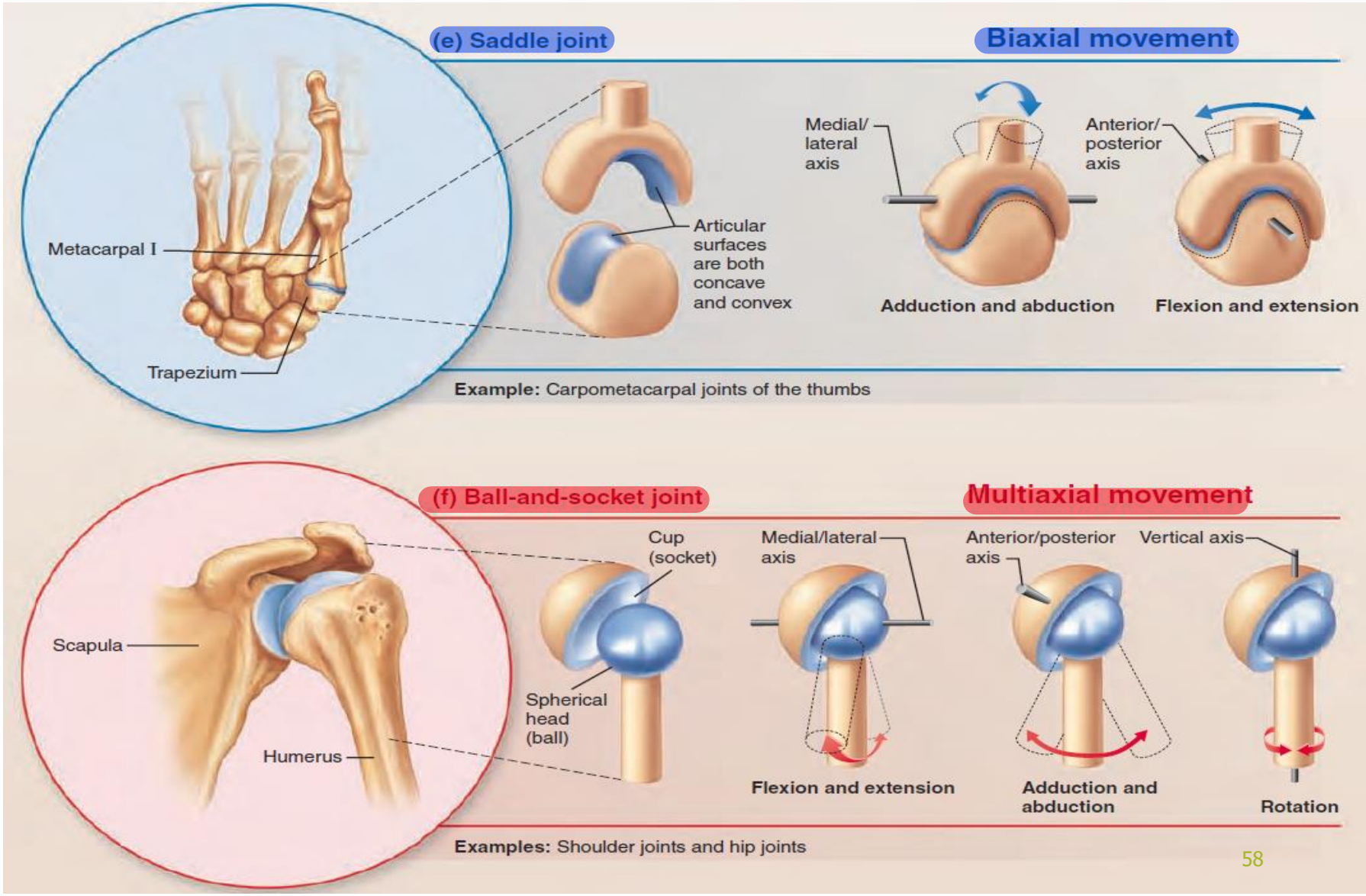


أنواع المفاصل الزليلية بناء على الشكل

Types of Synovial Joints Based on Shape



Types of Synovial Joints Based on Shape



Chapter 4

Muscular System

Hamza Abu Hilail
M.Sc. Physiology

Introduction

The purpose of the chapter is to:

- Learn about the structure and function of the 3 types of muscular tissue
- Examine the events at the neuromuscular junction
- Describe energy use in muscle cells
- Understand how muscle tension is controlled

Type and function of muscles

Types of Muscles:

1. Skeletal Muscles
2. Cardiac Muscle
3. Smooth muscles

1. العضلات الهيكلية
2. عضلة القلب
3. العضلات الملساء

Functions of Muscles:

1. Producing body movement
2. Stabilizing body position
3. Storing and moving substances within the body
4. Generating heat

1. إنتاج حركة الجسم
2. تثبيت وضع الجسم
3. تخزين ونقل المواد داخل الجسم
4. توليد الحرارة

Properties of Muscles

القدرة على الاستجابة لبعض المحفزات عن طريق إنتاج إشارة كهربائية

1. **Electrical Excitability**: ability to respond to certain stimuli by producing electrical signal

2. **Contractility**: ability of muscular tissue to contract forcefully when stimulated by an action potential

3. **Extensibility:** ability of muscle tissue to stretch without being damaged

4. **Elasticity**: ability of muscular tissue to return to its original length & shape after contraction or extension

SKELETAL MUSCLE TISSUE
(Connective tissue)

النسيج الضام

Three layers of connective tissue protect and strengthen skeletal muscle:

1. **Epimysium**: the outermost layer of dense, irregular connective tissue, encircling the entire muscle

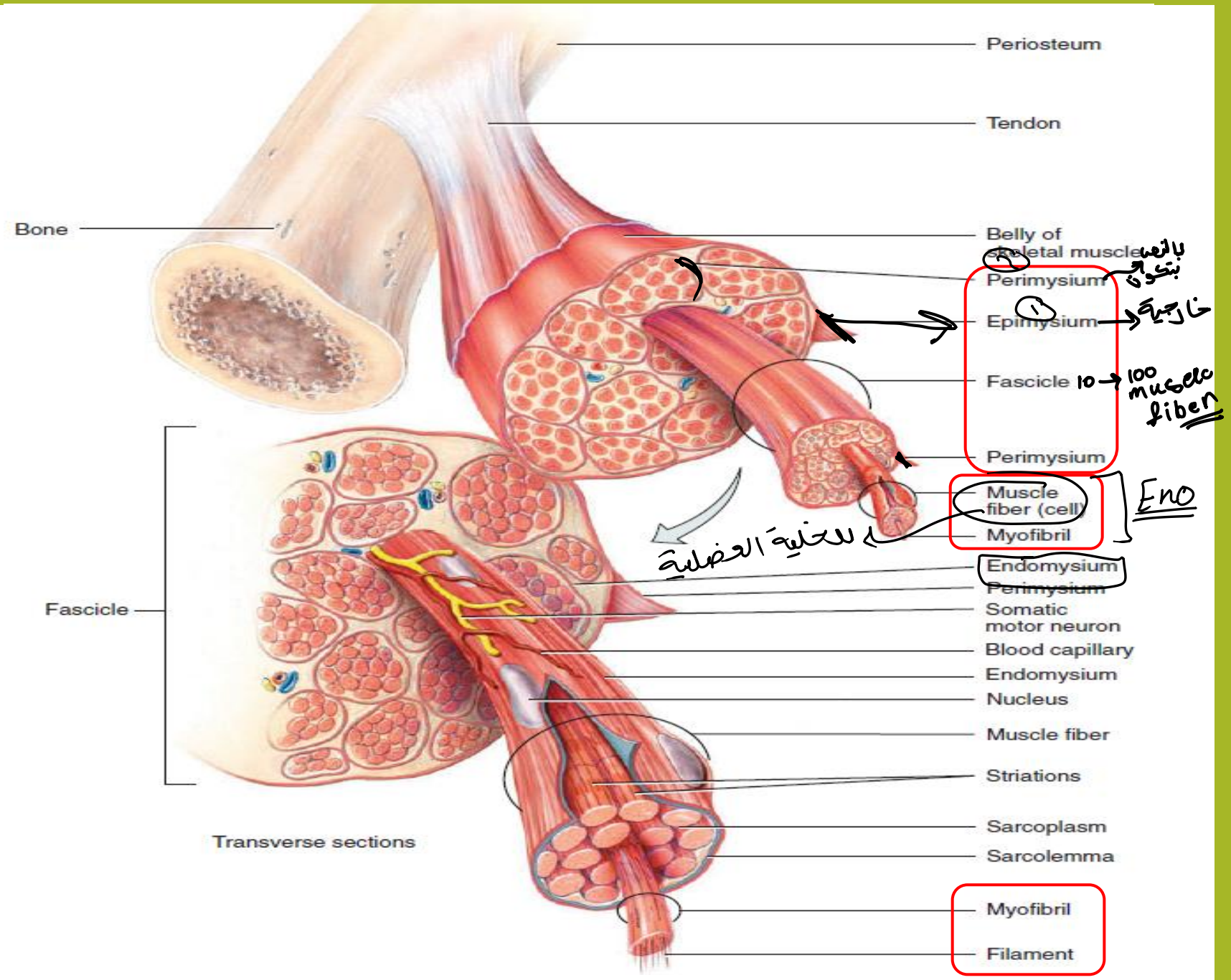
الطبقة الخارجية الكثيفة وغير المنتظمة
النسيج الضام، يحيط بالعضلة بأكملها

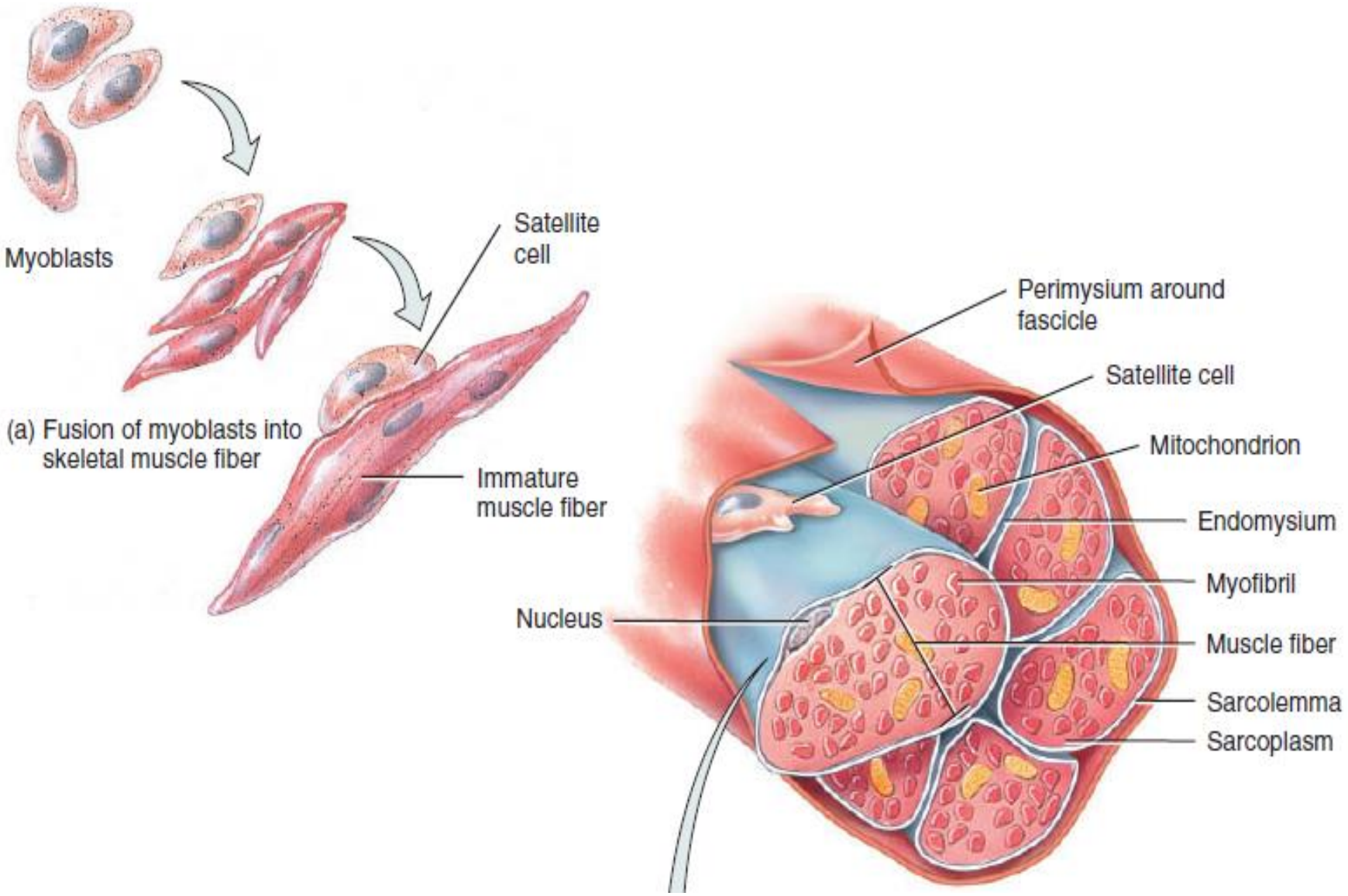
2. **Perimysium**: is also a layer of dense, irregular connective tissue, but it surrounds groups of 10 to 100 or more muscle fibers, separating them into bundles called fascicles

هي أيضا طبقة من الضام الكثيف وغير المنتظم
الأنسجة، ولكنها تحيط بمجموعات من 10 إلى 100 عضلة أو أكثر
الألياف، تفصلها إلى حزم تسمى الحزم

3. **Endomysium**: penetrates the interior of each fascicle and separates individual muscle fibers from one another. The endomysium is mostly reticular fibers.

يخترق الجزء الداخلي من كل حزمة و
يفصل ألياف العضلات الفردية عن بعضها البعض. ال
إن إندوميسيوم هو في الغالب ألياف شبكية.


Periosteum
Tendon
Bone
Belly of skeletal muscle
Perimysium
Epimysium
Fascicle
Perimysium
Muscle fiber (cell)
Myofibril
Endomysium
Perimysium
Somatic motor neuron
Blood capillary
Endomysium
Nucleus
Muscle fiber
Striations
Sarcoplasm
Sarcolemma
Myofibril
Filament
Fascicle
Transverse sections
بالنهاية بتكون
خارجية
10 → 100 muscle fiber
Endo
للخلية العضلية


Myoblasts
Satellite cell
(a) Fusion of myoblasts into skeletal muscle fiber
Immature muscle fiber
Perimysium around fascicle
Satellite cell
Mitochondrion
Endomysium
Myofibril
Nucleus
Muscle fiber
Sarcolemma
Sarcoplasm

إمدادات الأعصاب والدم

Nerve & blood supply

Sara Alzabari

- Generally, an artery and one or two veins accompany each nerve that penetrates a skeletal muscle.

بشكل عام، يصاحب الشريان وواحد أو اثنين من الأوردة كل عصب يخترق العضلات الهيكلية.

- The **neurons** that stimulate skeletal muscle to contract are **somatic motor neurons**.

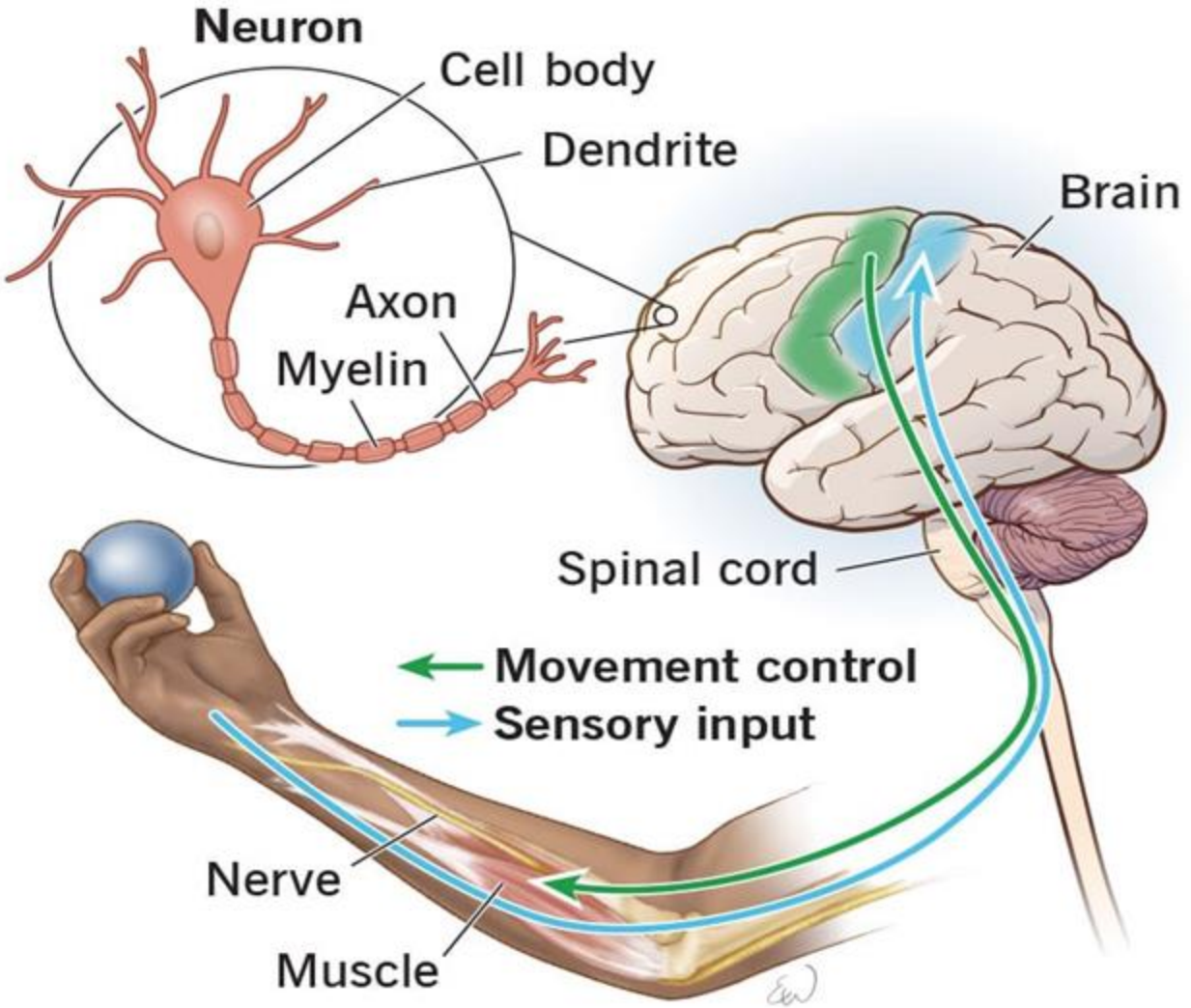
الخلايا العصبية التي تحفز العضلات الهيكلية من أجل العقد هو الخلايا العصبية الحركية الجسدية تحتوي كل خلية عصبية حركية جسدية على محور عصبي يمتد

- Each **somatic motor neuron** has axon that extends from the brain or spinal cord to a group of skeletal muscle fibers

من الدماغ أو الحبل الشوكي إلى مجموعة من الهياكل العظمية ألياف العضلات

- each muscle fiber is in close contact with one or more capillaries.

Somatic Nervous System



Microscopic Anatomy of skeletal muscles

- The **multiple nuclei** of a skeletal muscle fiber are located just beneath the sarcolemma

- **Sarcolemma**: the plasma membrane of a muscle cell

- **Transverse (T) tubules** : are tunnel in from the surface toward the center of each muscle fiber

الأنابيب المستعرضة (T): هي نفق من السطح نحو مركز كل ألياف عضلية

- Muscle action potentials travel along the sarcolemma and through the T tubules

Microscopic Anatomy of skeletal muscles

- **Sarcoplasm:** the cytoplasm of a muscle fiber.

✓ Sarcoplasm includes a substantial amount of **glycogen**

✓ Glycogen can be used for **synthesis of ATP**.

✓ Sarcoplasm contains a red-colored protein called **myoglobin**

✓ **Myoglobin** binds oxygen molecules that diffuse into muscle fibers from interstitial fluid.

الليفي العضلي والساركوبلازمي

الصبكية

Myofibril & Sarcoplasmic Reticulum

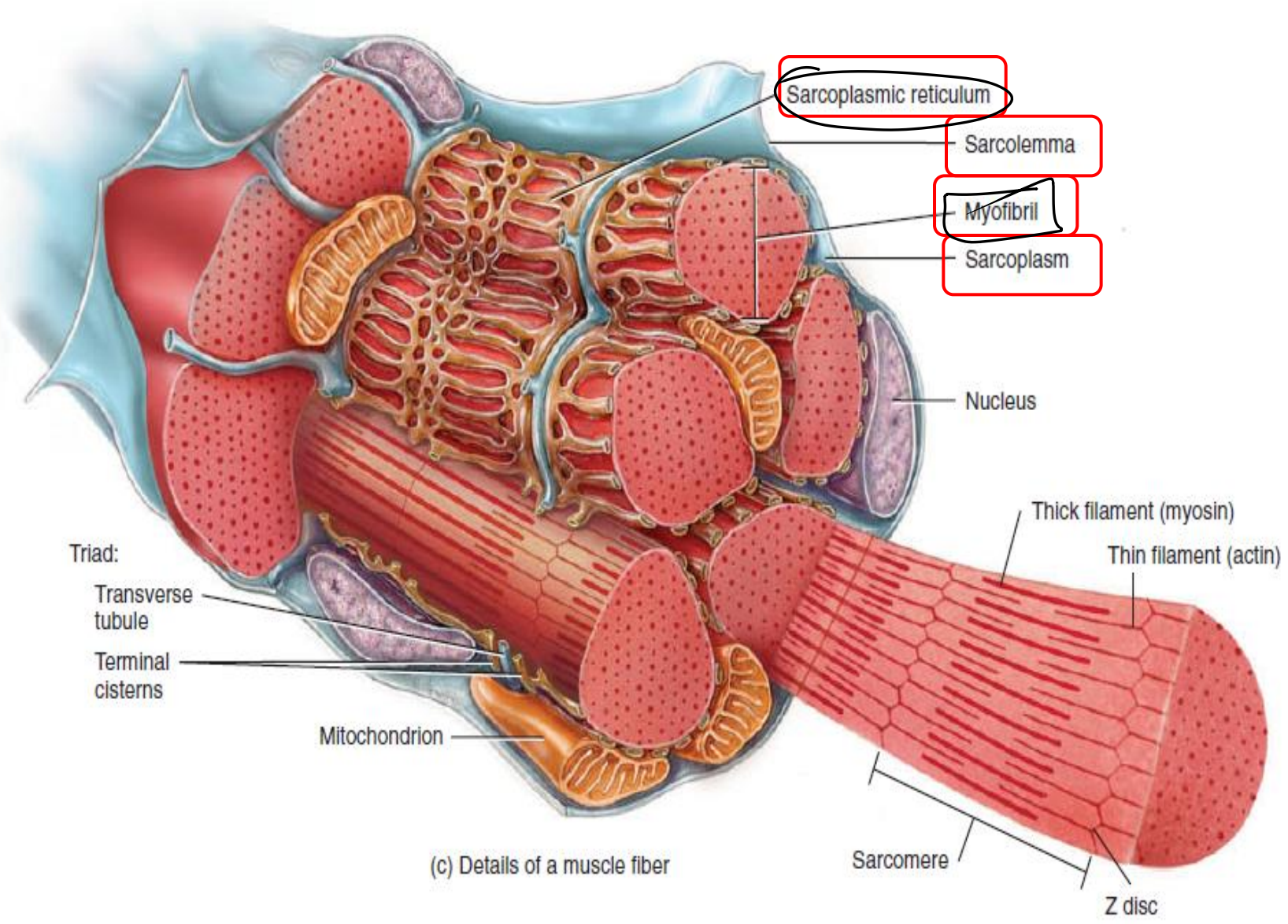
Myofibrils: الليف العضلي

- ✓ The contractile organelles of skeletal muscle (عضيات متقلصة)
- ✓ Their prominent striations make the entire skeletal muscle fiber appear striped (striated)

خطوطها البارزة تجعل العضلات الهيكلية بأكملها تبدو الألياف مخططة (مخططة)

Sarcoplasmic reticulum (SR)

- ✓ Is represented by the **endoplasmic reticulum** in the muscles
- ✓ Release of Ca_2 triggers muscle contraction. (تقلب)
- ✓ In a relaxed muscle fiber, the sarcoplasmic reticulum stores calcium ions (Ca_2).



(c) Details of a muscle fiber

خيوط وساركومير

Filaments & the sarcomere

- Myofibril is composed of **thin & thick filament**
- Filaments are arranged into **Sarcomeres**
- The extent of overlap of the thick and thin filaments depends on whether the muscle is contracted, relaxed, or stretched.
- The pattern of thick and thin filaments overlap, consisting of a **variety of zones** and **bands** creating the striations.

Filaments & the sarcomere

يمتد الجزء الأغمق من الساركومير على نطاق سميك

- **A band**: The sarcomere's darker part extends the thick filaments' entire length.

طول الخيوط بالكامل

هو جزء أخف وزنا، يحتوي على الأكتين فقط

- **The I band:** is a lighter part, that contains only actin filaments

خيوط

يمر عبر مركز كل نطاق I.

- **Z disc:** passes through the center of each I band.

✓ Separates one sarcomere from the other

1. **H zone:** in the center of each A band contains thick but not thin filaments.

- Supporting proteins that hold the thick filaments together at the center of the H zone form the **M line**

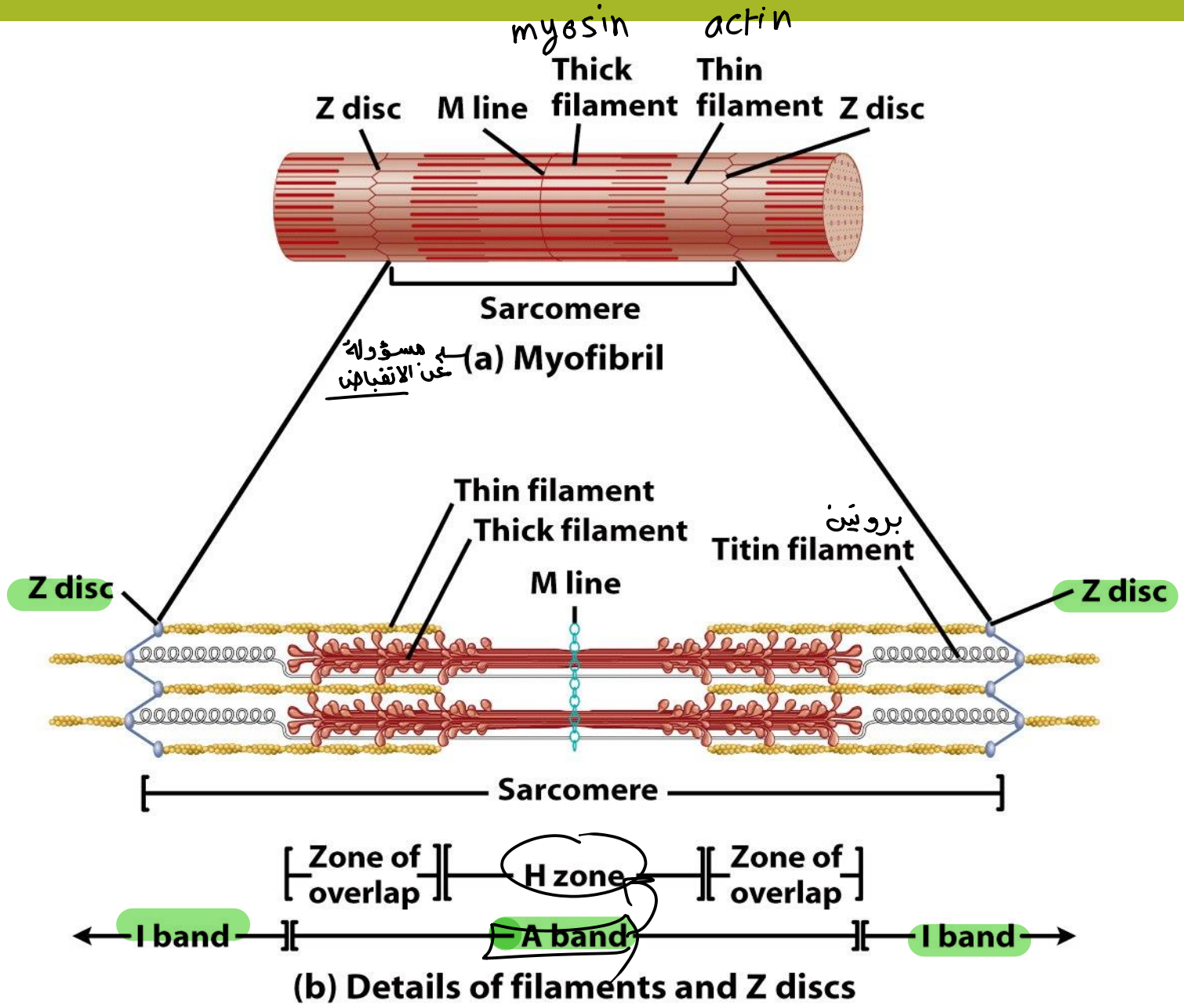


Figure 10-3 Principles of Anatomy and Physiology, 11/e

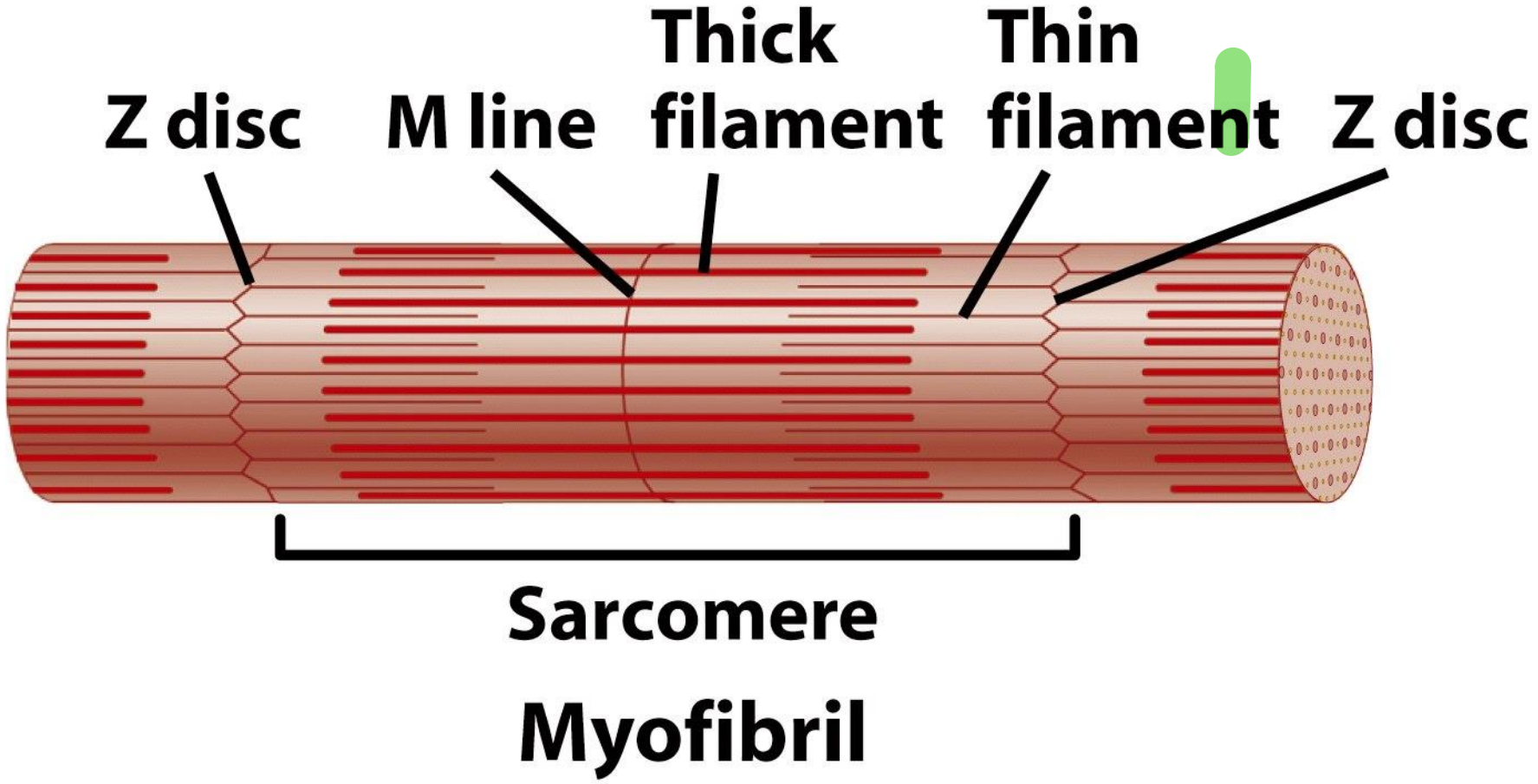


Figure 10-3a Principles of Anatomy and Physiology, 11/e

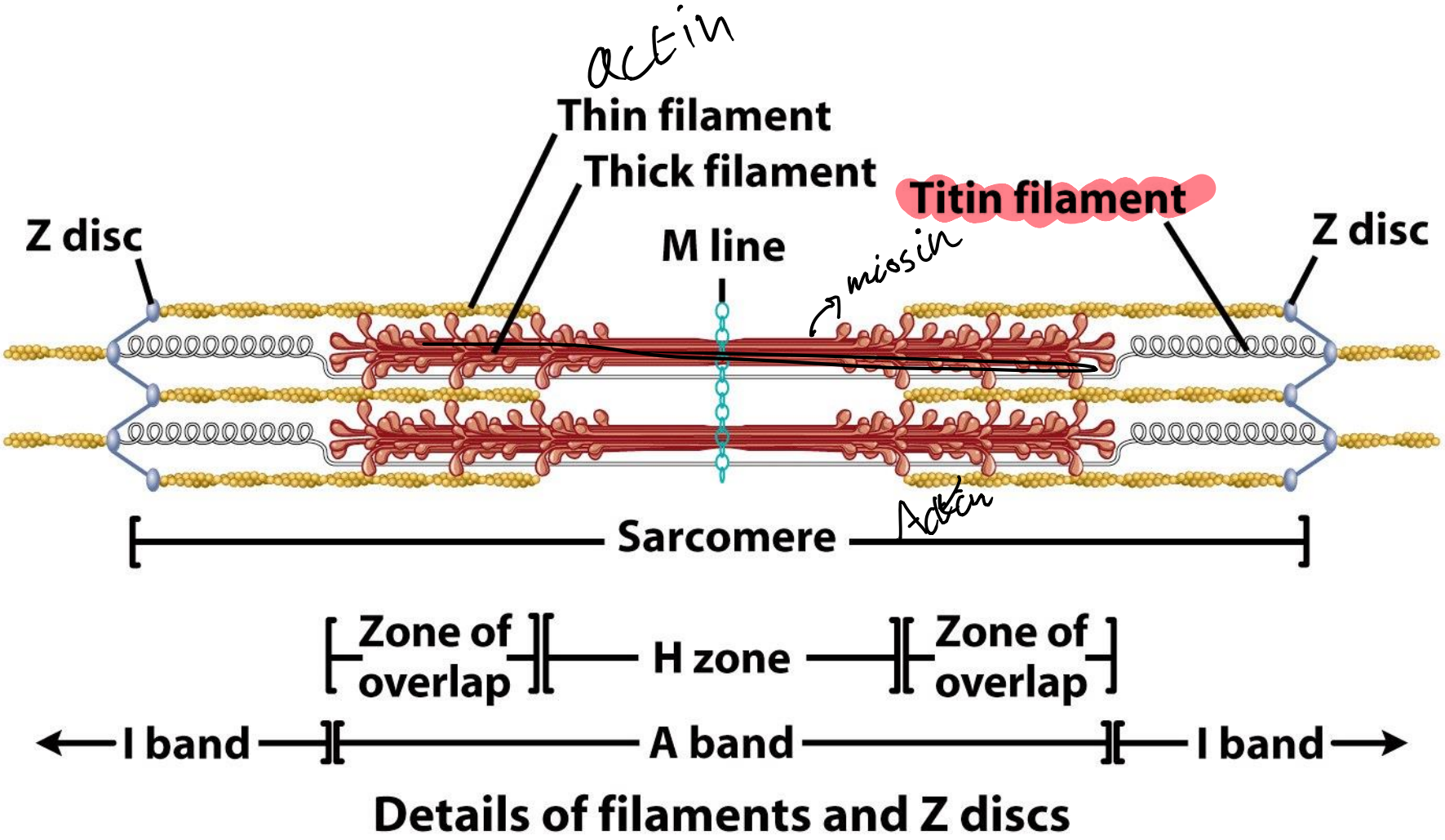


Figure 10-3b Principles of Anatomy and Physiology, 11/e

Muscle Proteins

متقلص

Contractile

1. Actin
2. Myosin

هيكلي

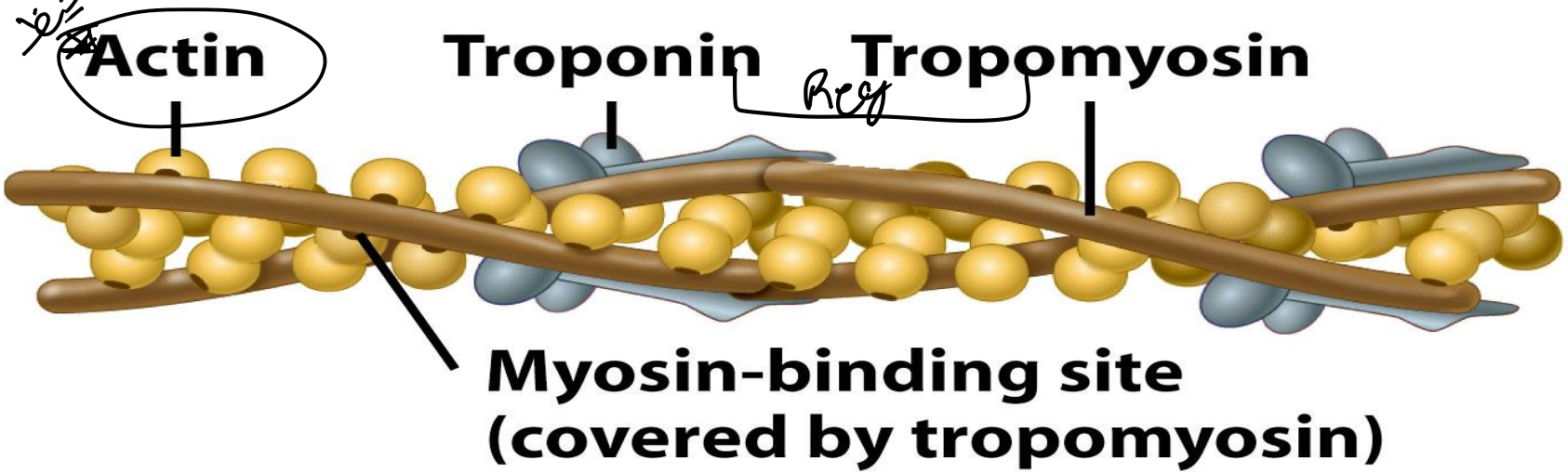
Structural

1. Titin

تنظيمي

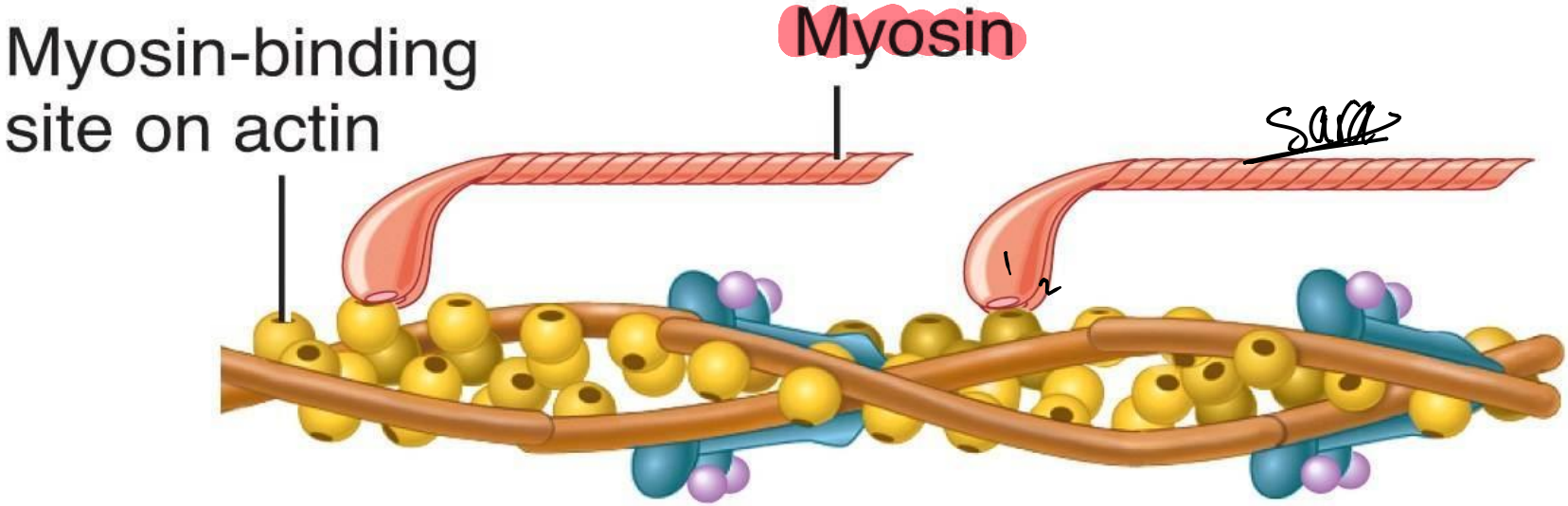
Regulatory

1. Troponin
2. Tropomyosin



Portion of a thin filament

Figure 10-5b Principles of Anatomy and Physiology, 11/e



التقاطع العصبي العضلي

The Neuromuscular Junction (NMJ)

الخلايا العصبية الحركية الجسدية — إطلاق الأسيتيل كولين

Somatic motor neurons → release acetylcholine

الشق المشبكي — لوحة نهاية المحرك

NMJ → synaptic cleft → Motor end plate →

يحتوي على 30-40 مليون مستقبلات ACH

contain 30-40 million ACH receptors

تنشيط مستقبلات ACH →

→Activation of ACH receptors → channel open

تدفق الصوديوم عبر الغشاء

→ sodium flow across membrane → Production of muscle action potential

إنتاج

من إمكانات عمل العضلات

- Termination of Ach activity: acetylcholinesterase breaks down Ach into acetyl and choline

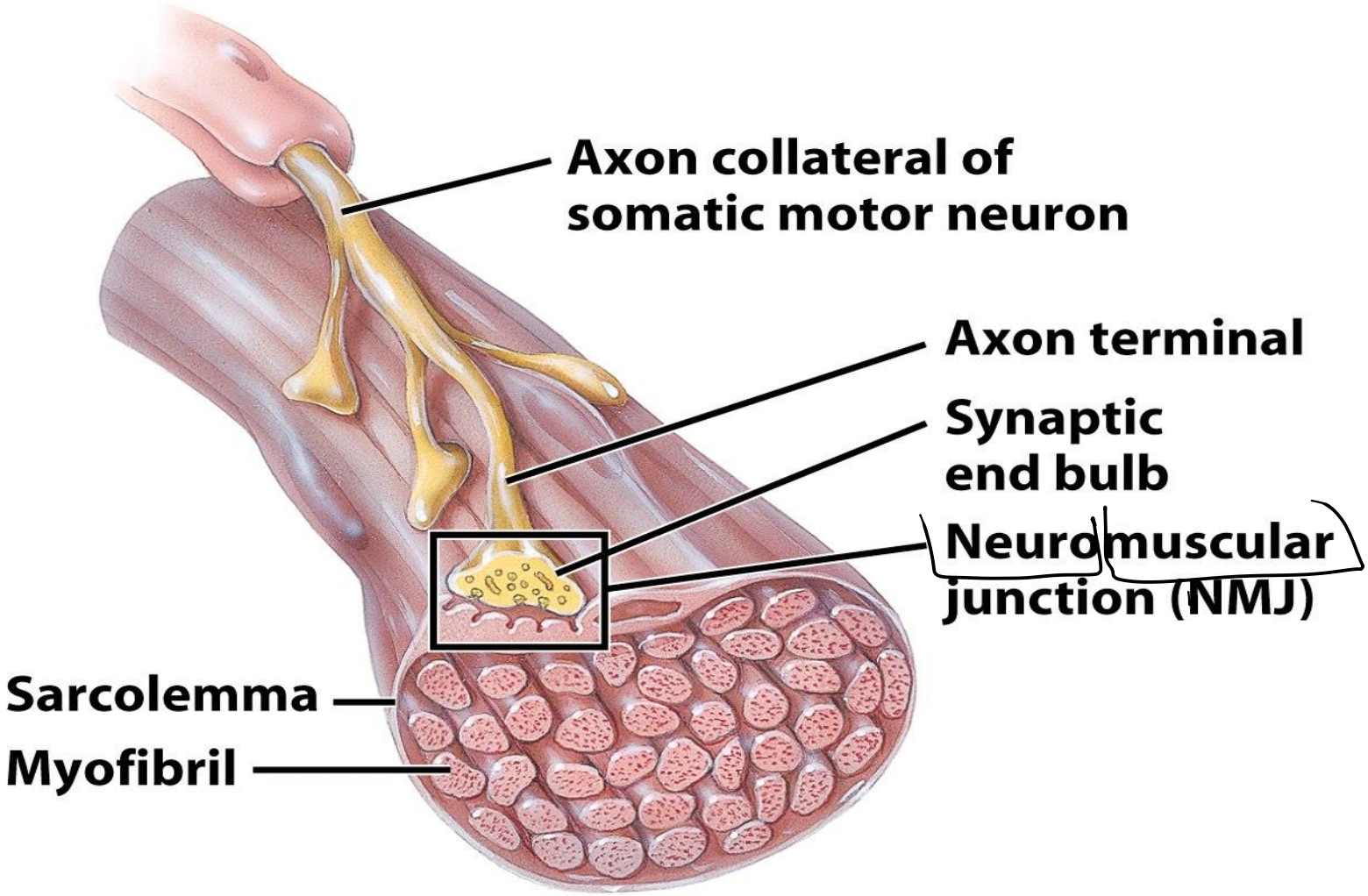
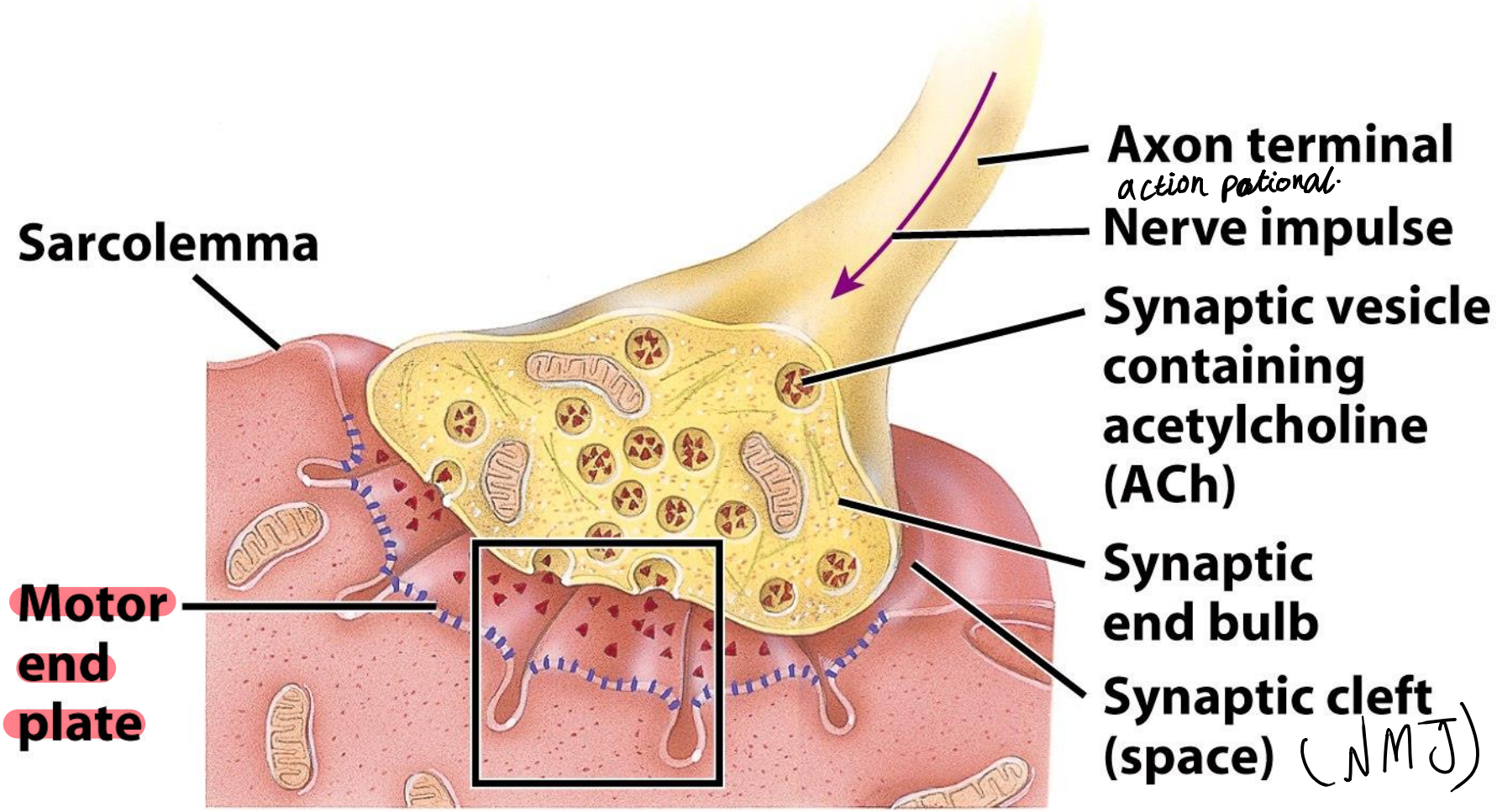


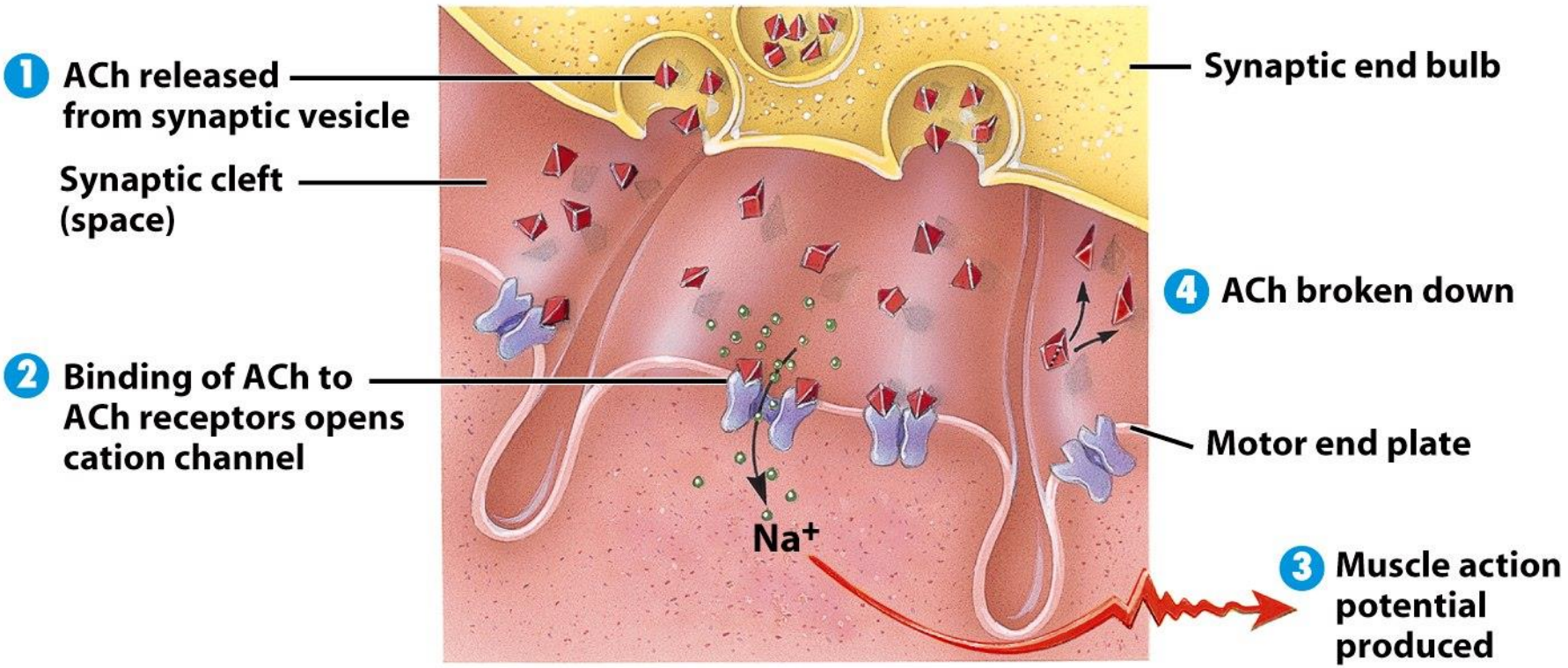
Figure 10-10a Principles of Anatomy and Physiology, 11/e



Enlarged view of the neuromuscular junction

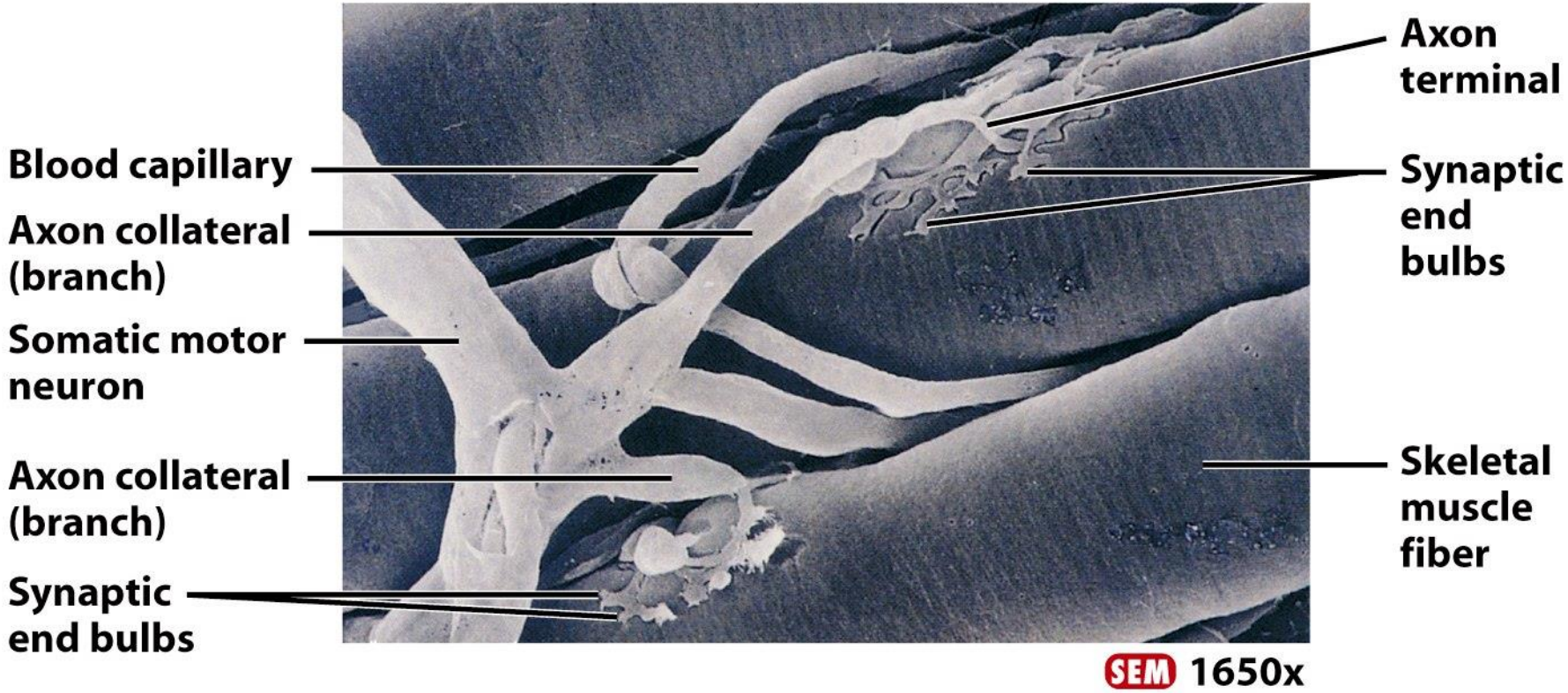
Figure 10-10b Principles of Anatomy and Physiology, 11/e

Sara Alzatari



Binding of acetylcholine to ACh receptors in the motor end plate

Figure 10-10c Principles of Anatomy and Physiology, 11/e



Neuromuscular junction

Figure 10-10d Principles of Anatomy and Physiology, 11/e

اقتران الإثارة والانكماش

Excitation-Contraction Coupling

Excitation → contraction

ينتشر AP على طول ساركولما وفي الأنابيب التائية

AP propagate along sarcolemma and into T tubules → تدفق الكالسيوم إلى

قنوات إطلاق الكالسيوم في SR مفتوحة

calcium release channels in SR open → calcium flow into السيتوسول حول خيوط سميكة ورقيقة

cytosol around thick & thin filament → calcium bind with نقل التروبوميوسين

يرتبط الكالسيوم مع

التروبونين يغير شكله

troponin → troponin change its shape → move tropomyosin بعيداً عن مواقع ربط الميوسين

تروبونين

تصبح المواقع مجانية

away from the myosin binding sites → sites become free →

myosin heads bind to the sites → contraction cycle begins

ترتبط رؤوس الميوسين بالمواقع

تبدأ دورة الانقباض

Relaxation

Calcium active transport pump → use ATP to move calcium from cytosol to SR → Relaxation

1 **Myosin heads hydrolyze ATP and become reoriented and energized**

Key:
● = Ca^{2+}

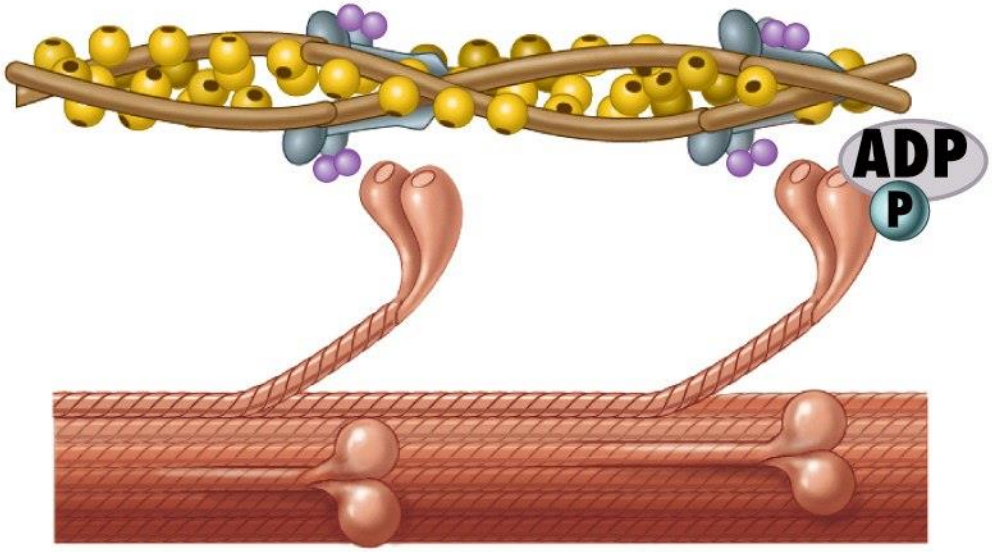


Figure 10-7 part 1 Principles of Anatomy and Physiology, 11/e

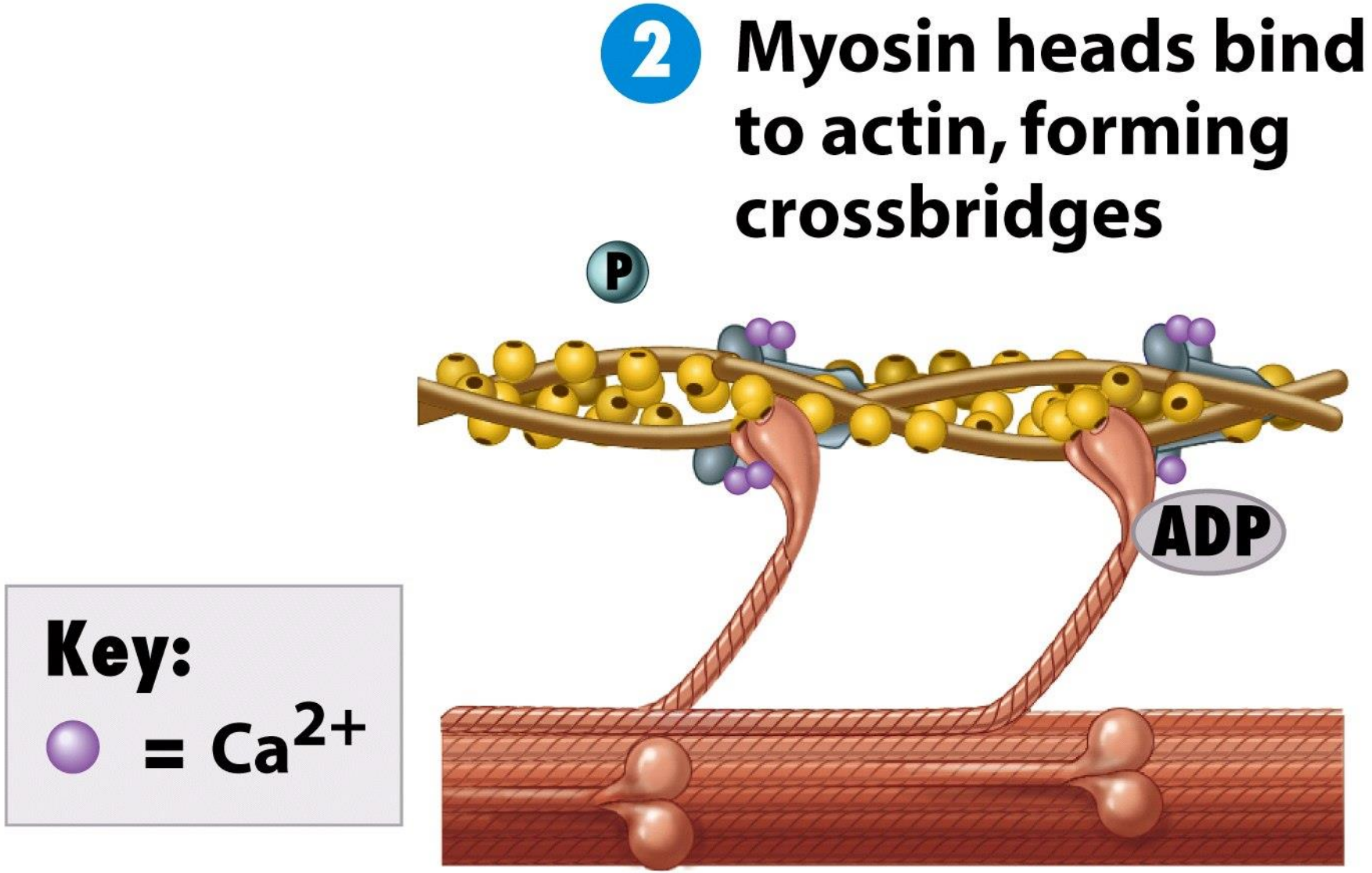


Figure 10-7 part 2 Principles of Anatomy and Physiology, 11/e

Key:

● = Ca^{2+}

3 **Myosin crossbridges rotate toward center of the sarcomere (power stroke)**

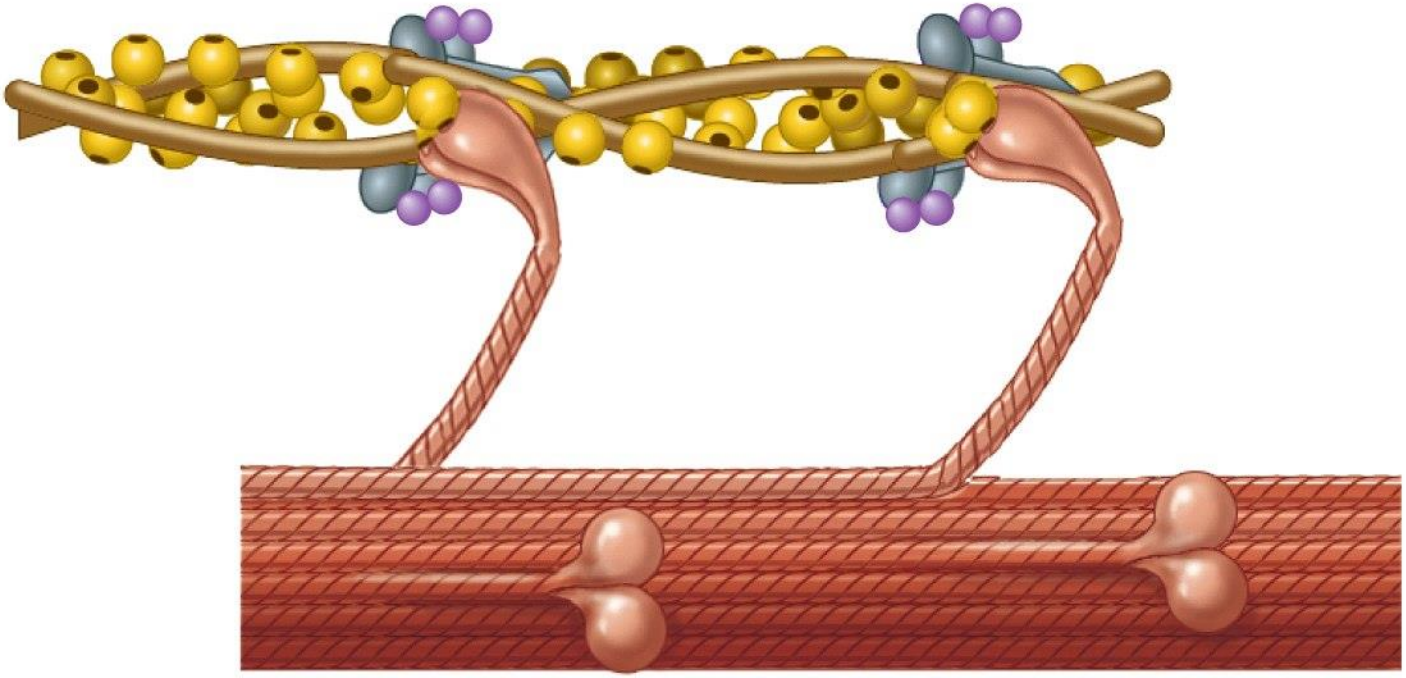
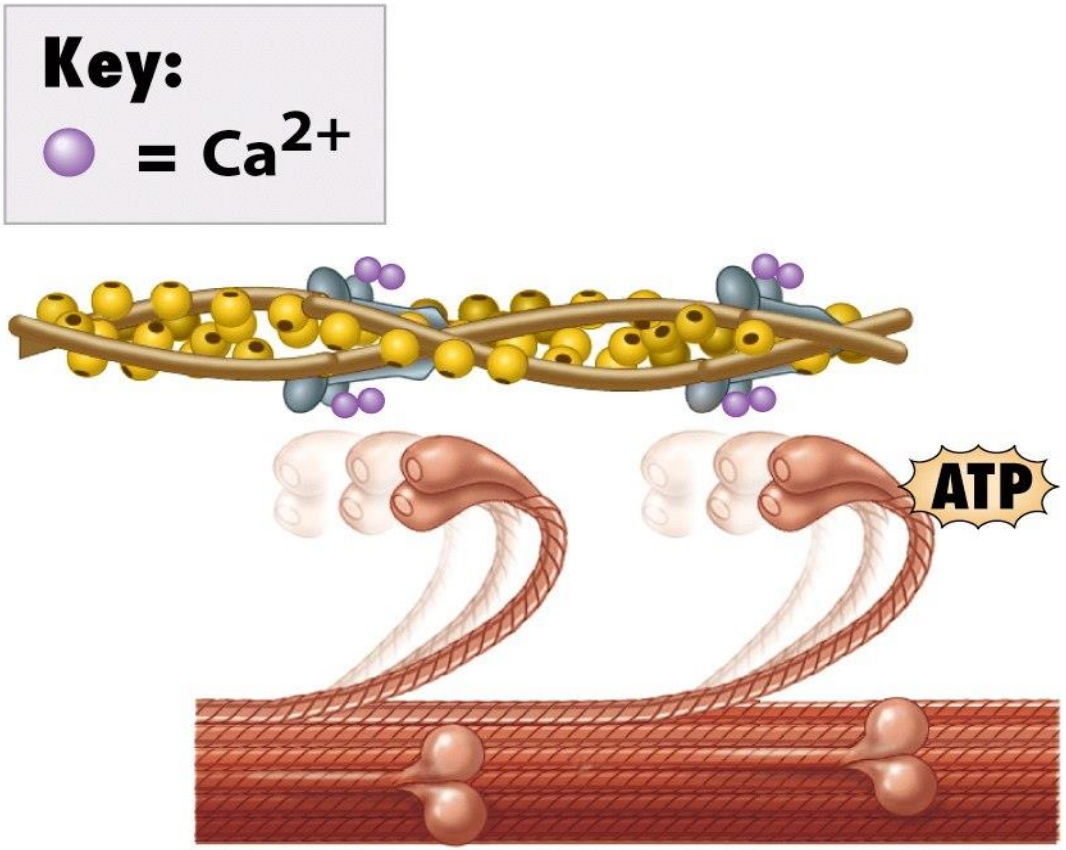


Figure 10-7 part 3 Principles of Anatomy and Physiology, 11/e



4 As myosin heads bind ATP, the crossbridges detach from actin

Figure 10-7 part 4 Principles of Anatomy and Physiology, 11/e

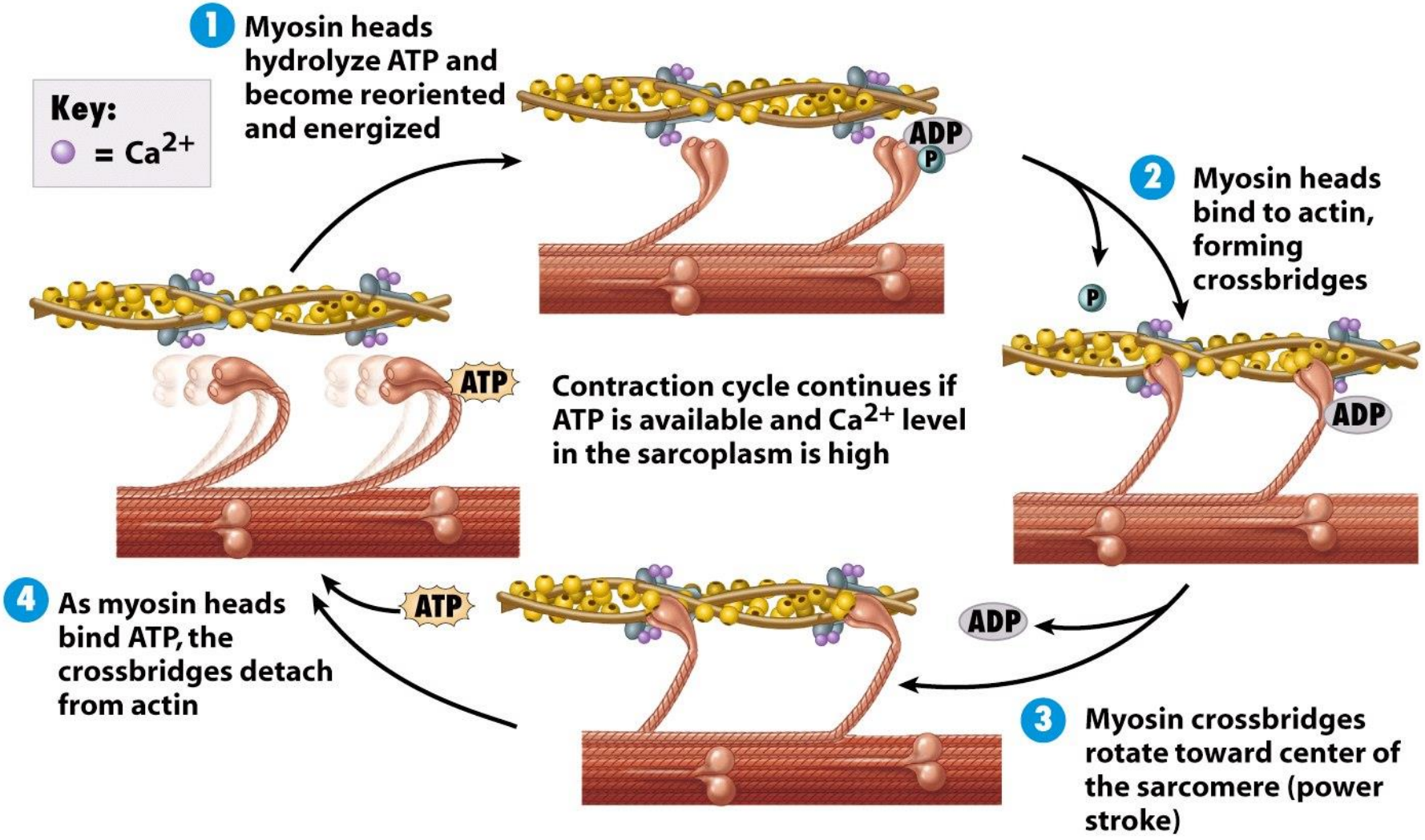


Figure 10-7 Principles of Anatomy and Physiology, 11/e

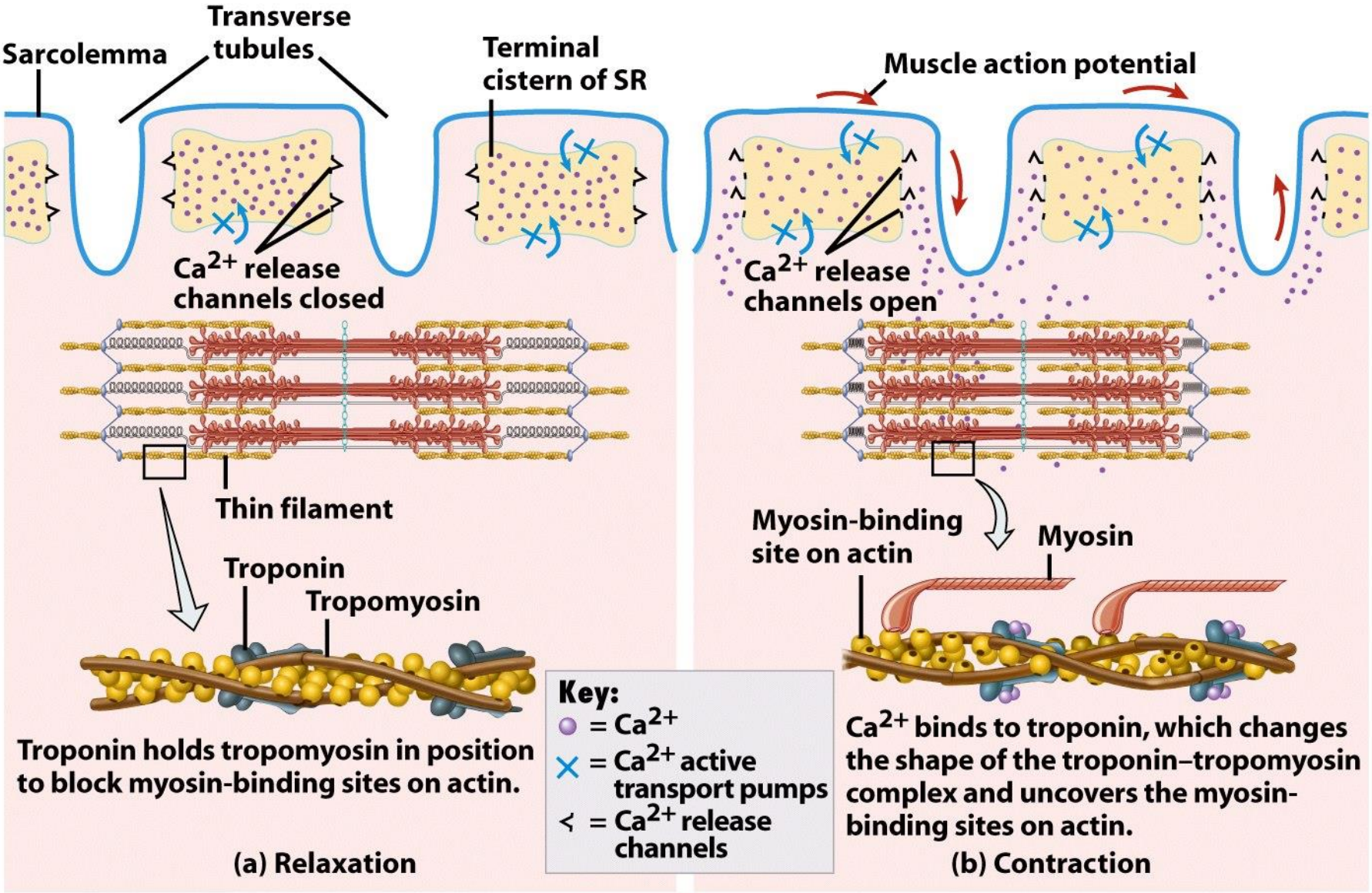


Figure 10-8 Principles of Anatomy and Physiology, 11/e

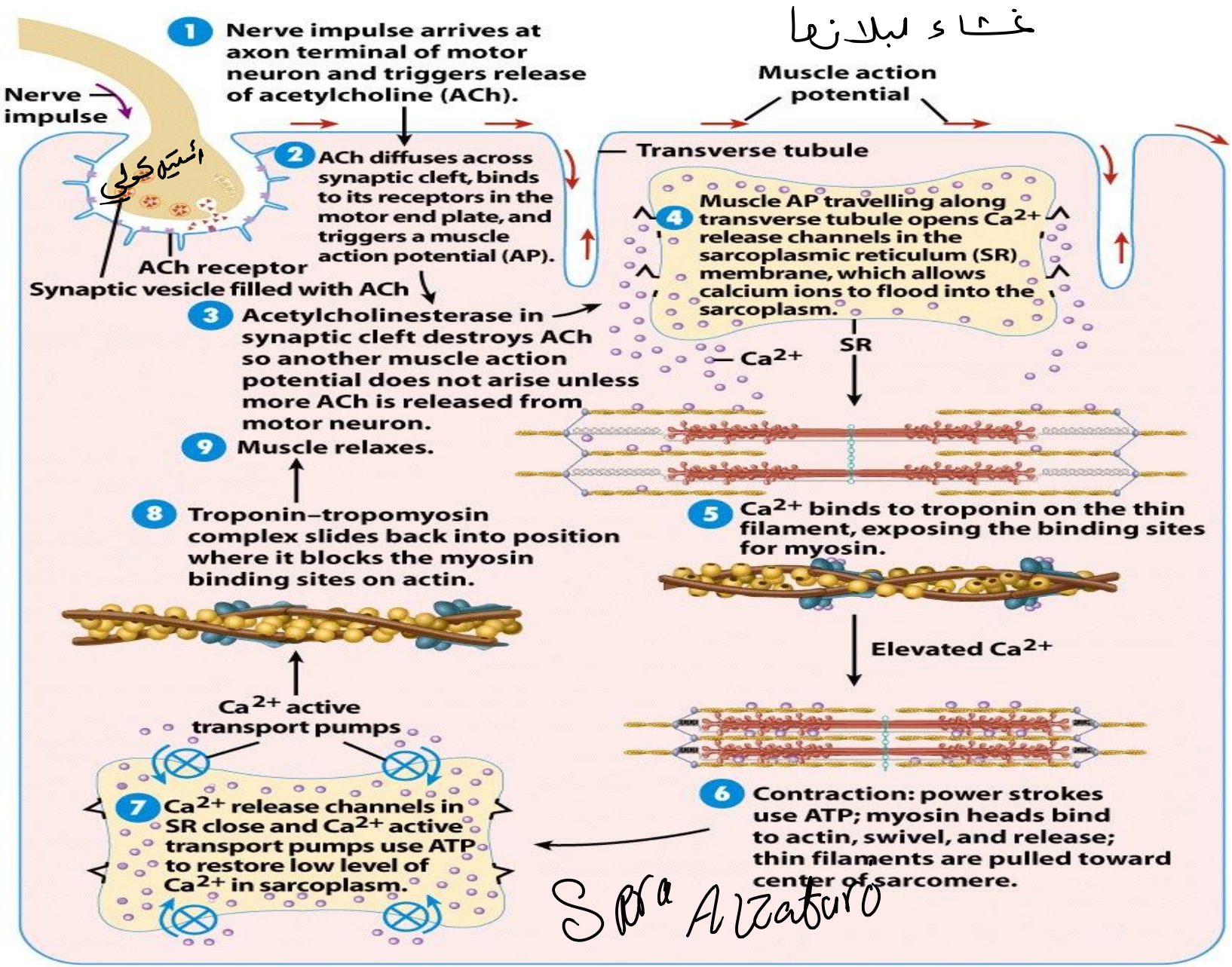
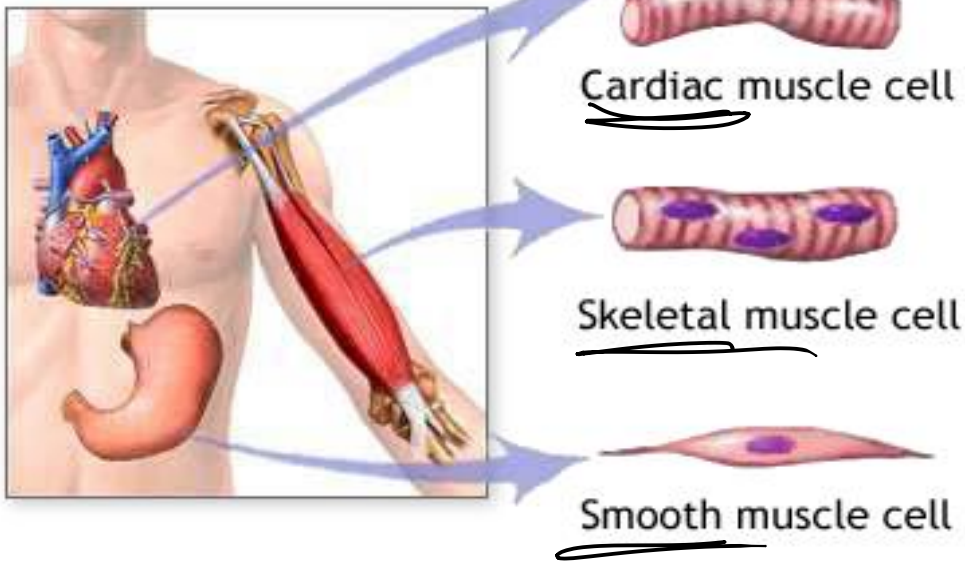


Figure 10-11 Principles of Anatomy and Physiology, 11/e

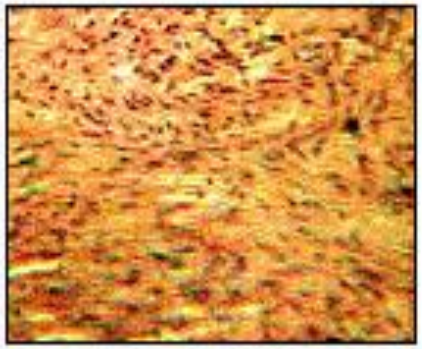
Table 4.3 Features of Muscle Tissue

Type	Location	Structure and Function
Smooth muscle	Walls of hollow organs	Elongated, spindle-shaped fiber with single nucleus; non-striated, involuntary
Cardiac muscle	Wall of the heart	Branched, striated fiber with single nucleus and intercalated discs; involuntary rhythmic contraction
Skeletal muscle	Spanning joints of skeleton via tendons	Multinucleated, striated, cylindrical fibers; voluntary

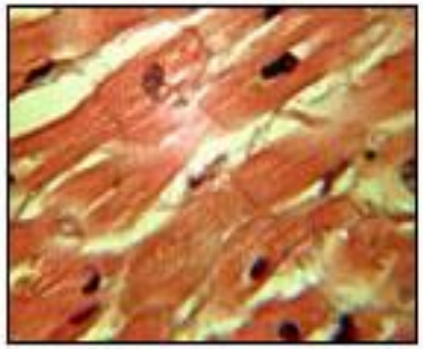


A.D.A.M.

Skeletal muscle



Smooth muscle



Cardiac muscle

Anatomy of the muscles

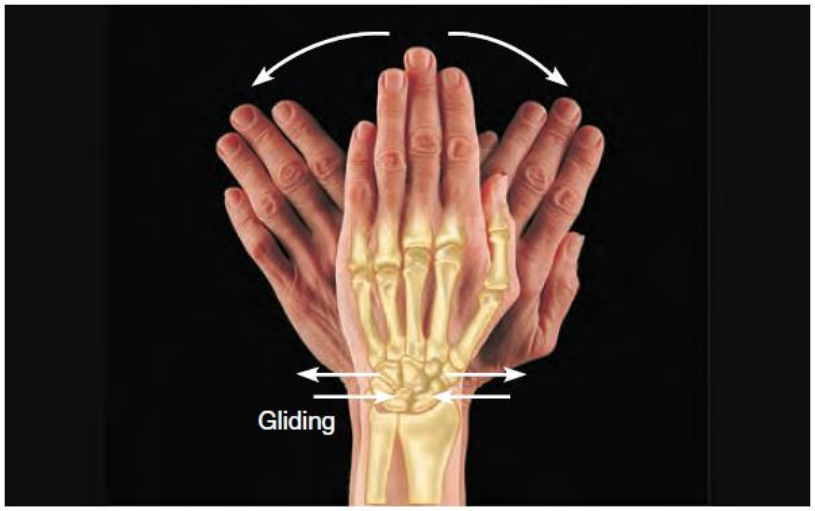
Terms Related to movements

- Flexion
- Extension
- Hyperextension
- Abduction
- Adduction
- Circumduction
- Rotation

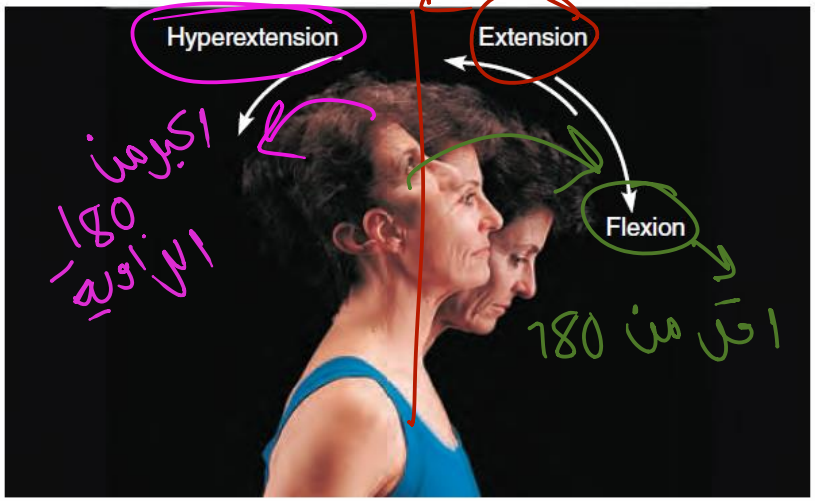
Terms Related to movements

- **Flexion:** bending movement, that decreases the angle of the joint and **brings the articulating bones closer together**
- **Extension:** is the **reverse of flexion** and occurs at the same joints
- **Hyperextension:** Continuing such movements beyond the anatomical position

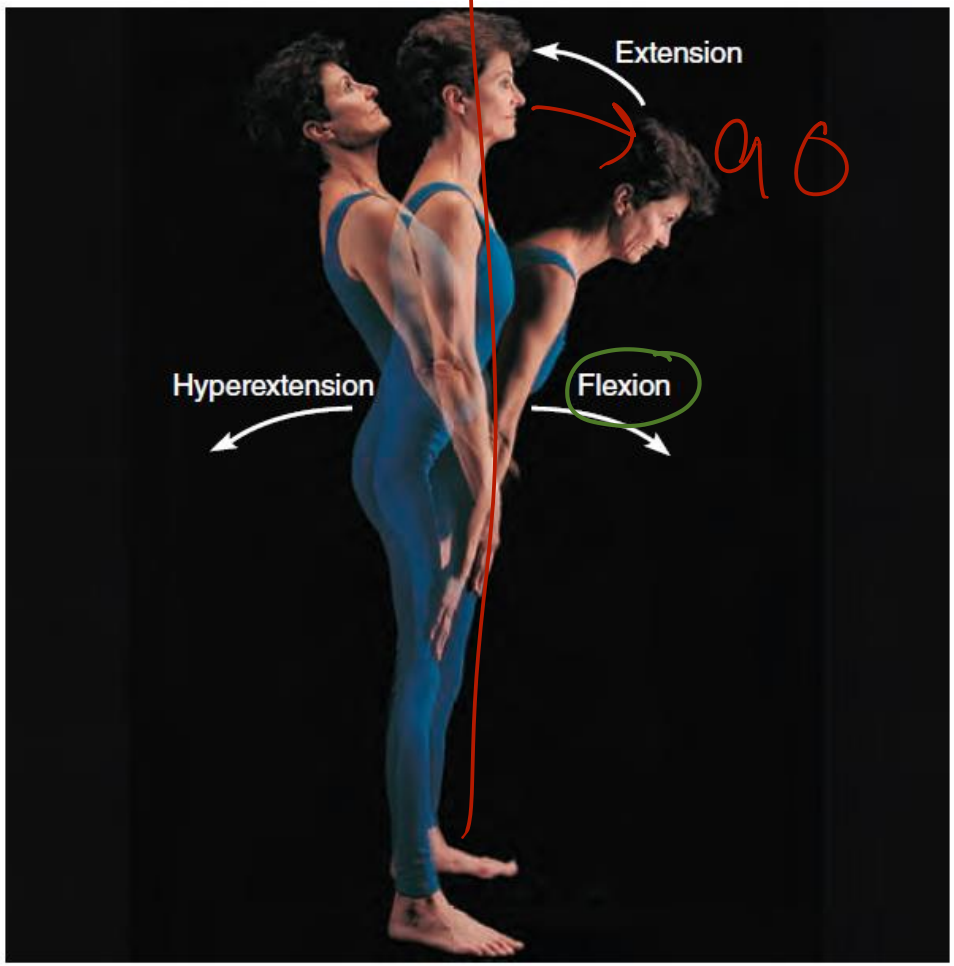
Terms Related to movements



(a) Gliding movements at the wrist

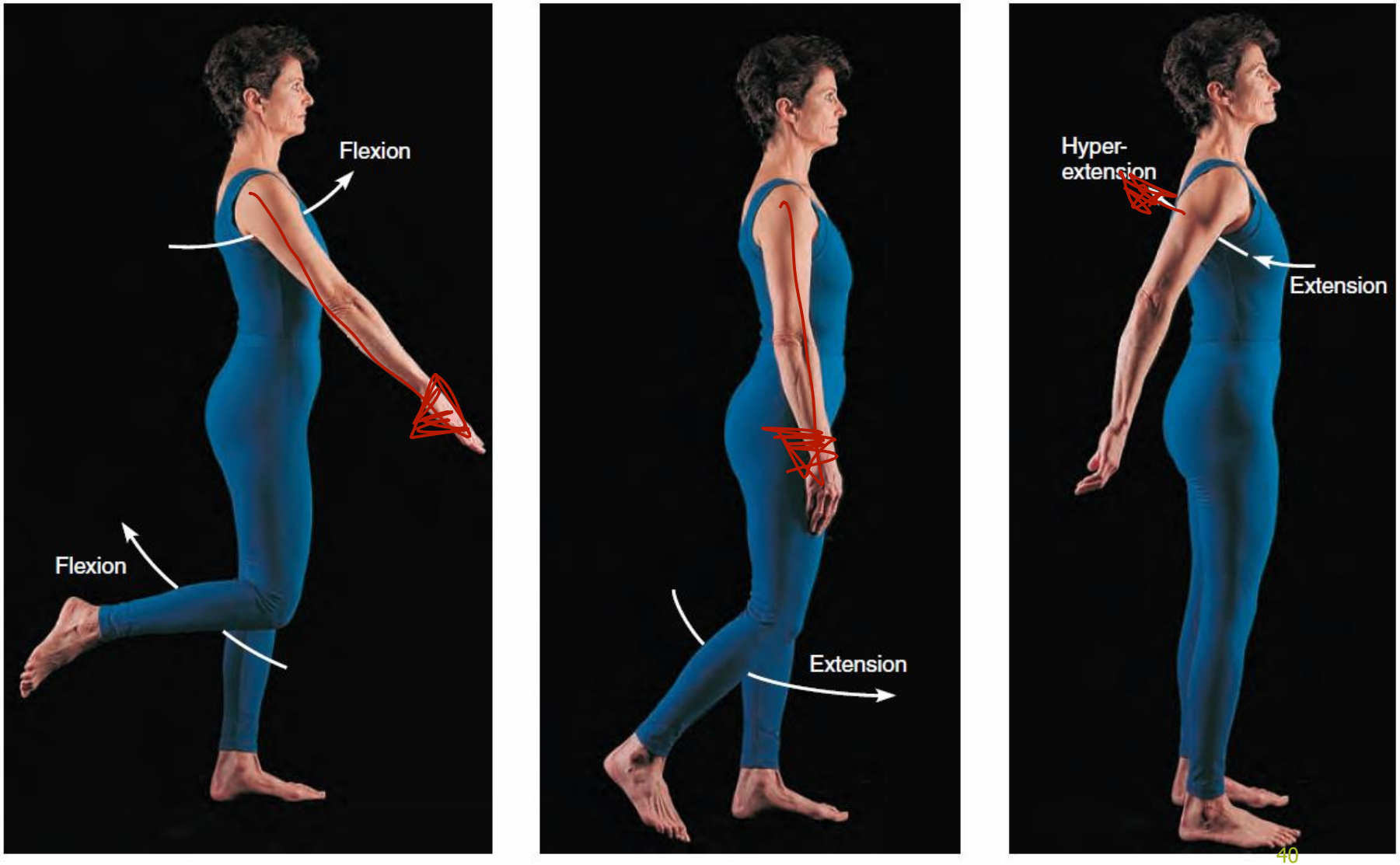


(b) Angular movements: flexion, extension, and hyperextension of the neck



(c) Angular movements: flexion, extension, and hyperextension of the vertebral column

Terms Related to movements

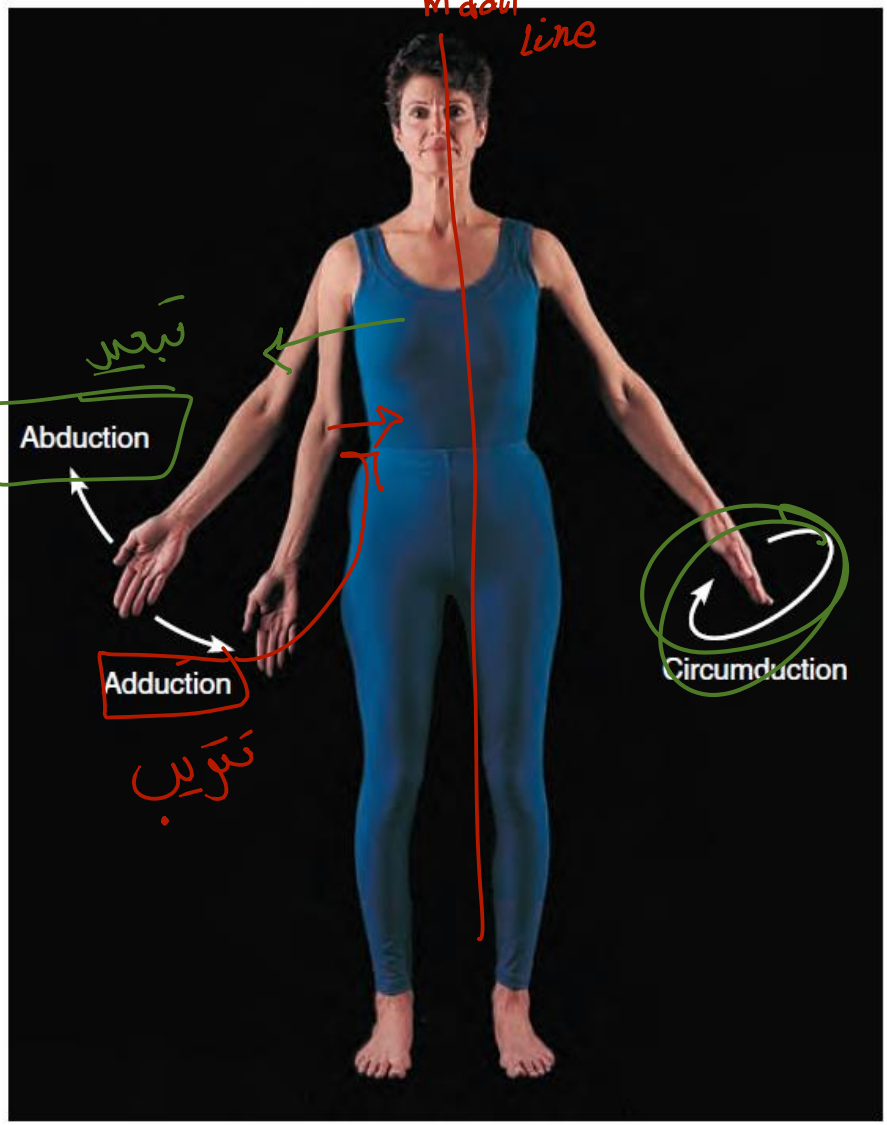


(d) Angular movements: flexion, extension, and hyperextension at the shoulder and knee

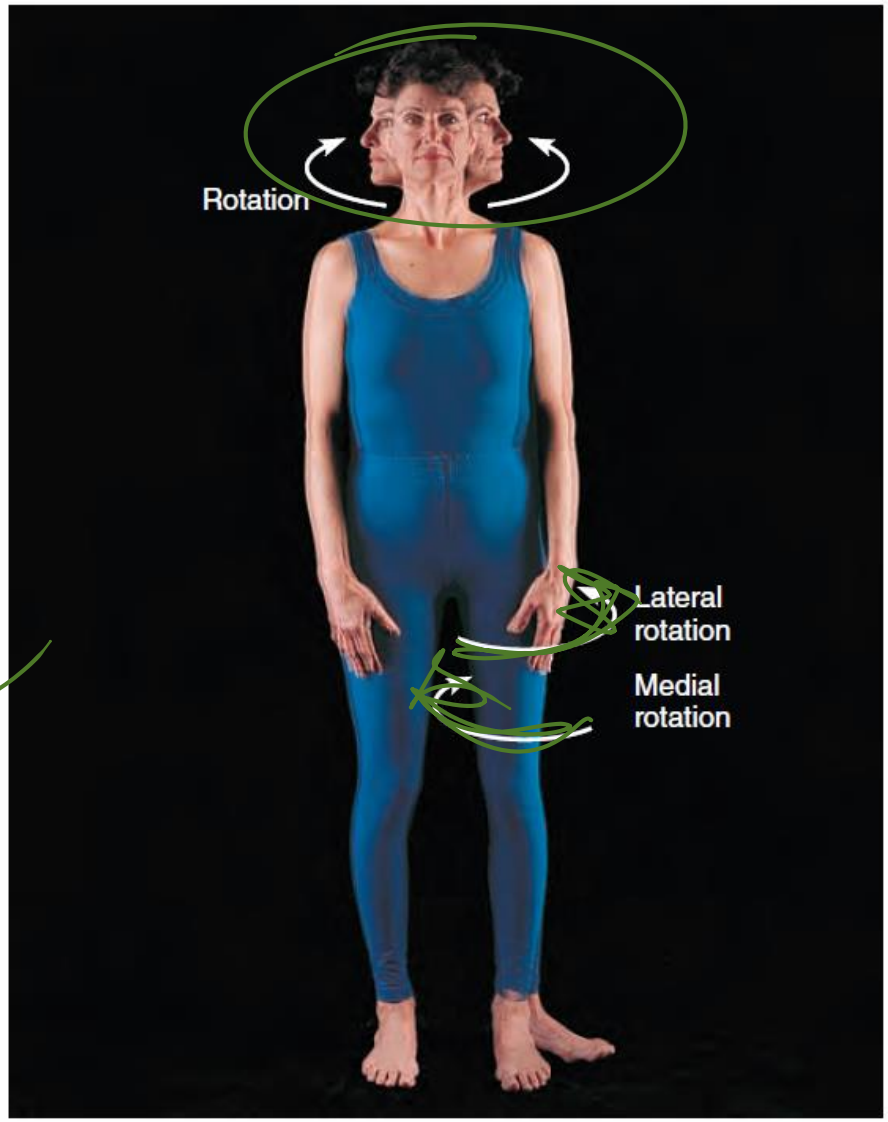
Terms Related to movements

- **Abduction (“moving away”):** is the movement of a limb away from the midline or median plane of the body
- **Adduction (“moving toward”):** is the opposite of abduction, so it is the movement of a limb toward the body midline
- **Circumduction:** is the movement of the limb, hand, or fingers in a circular pattern, using the sequential combination of flexion, adduction, extension, and abduction motions
- **Rotation:** is the turning of a bone around its long axis

Terms Related to movements



(e) Angular movements: abduction, adduction, and circumduction of the upper limb at the shoulder



(f) Rotation of the head, neck, and lower limb

Naming of Skeletal Muscles

Individual muscles are named according to their:

Shape:

1. **Deltoid**: Triangular
2. **Rectus**: Straight

Size:

1. **Major:** Large
2. **Latissimus**: Broadest

Number of heads:

1. **Biceps**: Two heads
2. **Quadriceps**: Four heads

Position:

1. **Pectoralis**: Of the chest
2. **Brachii**: Of the arm

Naming of Skeletal Muscles

Individual muscles are named according to their:

Depth

1. **Superficialis:** Superficial
2. **Externus:** External

Attachments

1. **Sternocleidomastoid**: From sternum and clavicle to mastoid process.

Actions

1. **Extensor**: Extend
2. **Flexor**: Flex
3. **Constrictor**: Constrict

Arrangement of Fascicles

PARALLEL

Fascicles parallel to longitudinal axis of muscle; terminate at either end in flat tendons.

Example: Sternohyoid muscle (see Figure 11.8a)

FUSIFORM

Fascicles nearly parallel to longitudinal axis of muscle; terminate in flat tendons; muscle tapers toward tendons, where diameter is less than at belly.

Example: Digastric muscle (see Figure 11.8a)

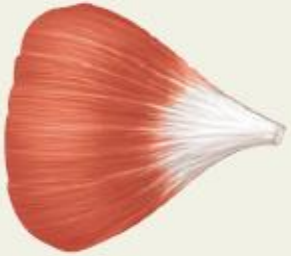
CIRCULAR

Fascicles in concentric circular arrangements form sphincter muscles that enclose an orifice (opening).

Example: Orbicularis oculi muscle (see Figure 11.4a)

TRIANGULAR

Fascicles spread over broad area converge at thick central tendon; gives muscle a triangular appearance.



Example: Pectoralis major muscle (see Figure 11.3a)

PENNATE

Short fascicles in relation to total muscle length; tendon extends nearly entire length of muscle.

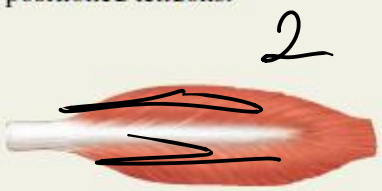
UNIPENNATE

Fascicles arranged on only one side of tendon.

Example: Extensor digitorum longus muscle (see Figure 11.22b)

BIPENNATE

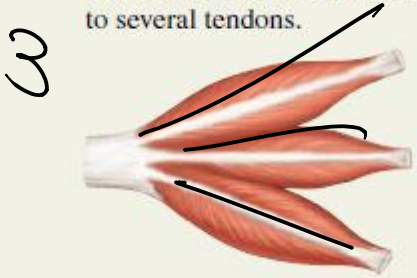
Fascicles arranged on both sides of centrally positioned tendons.



Example: Rectus femoris muscle (see Figure 11.20a)

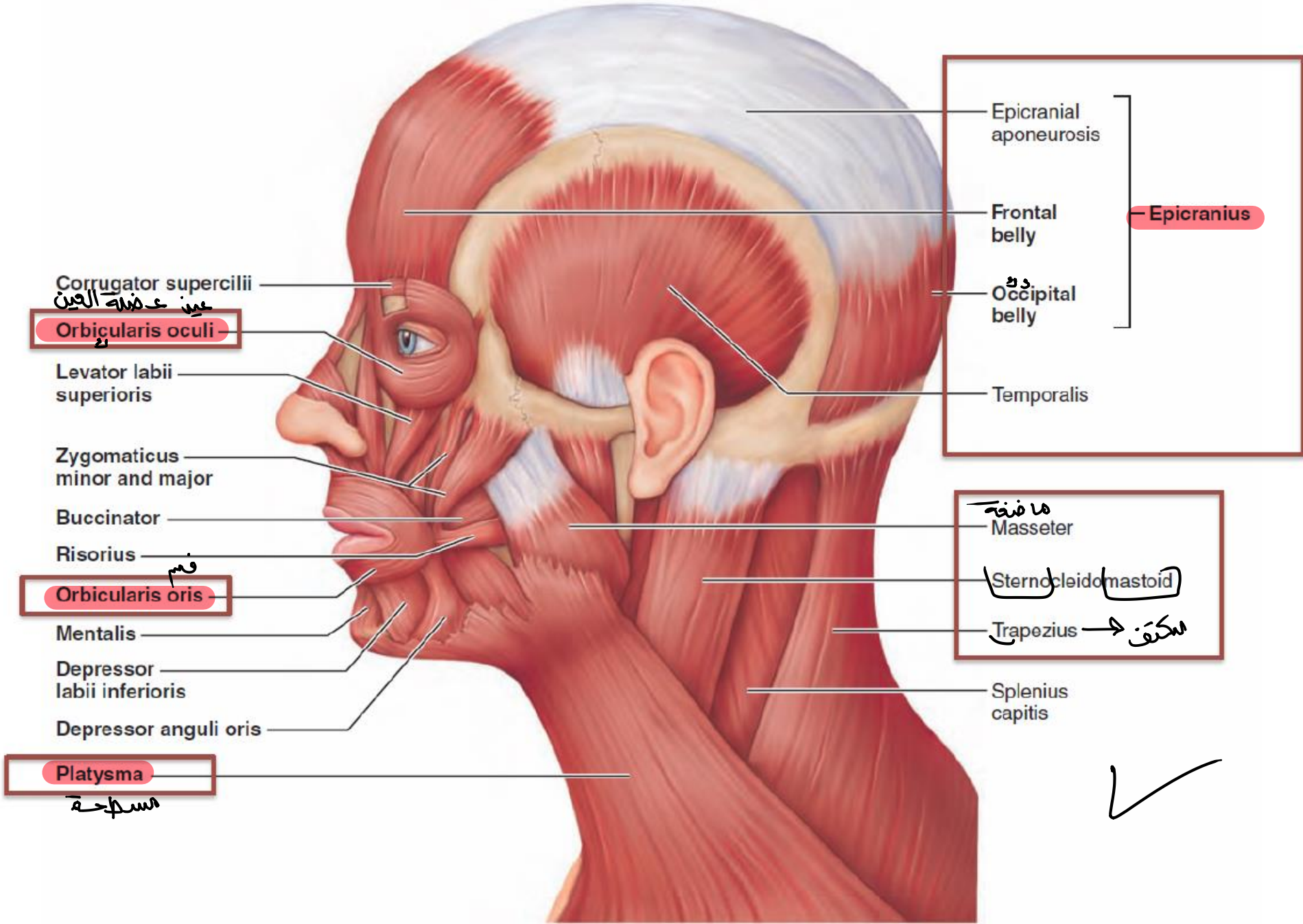
MULTIPENNATE

Fascicles attach obliquely from many directions to several tendons.

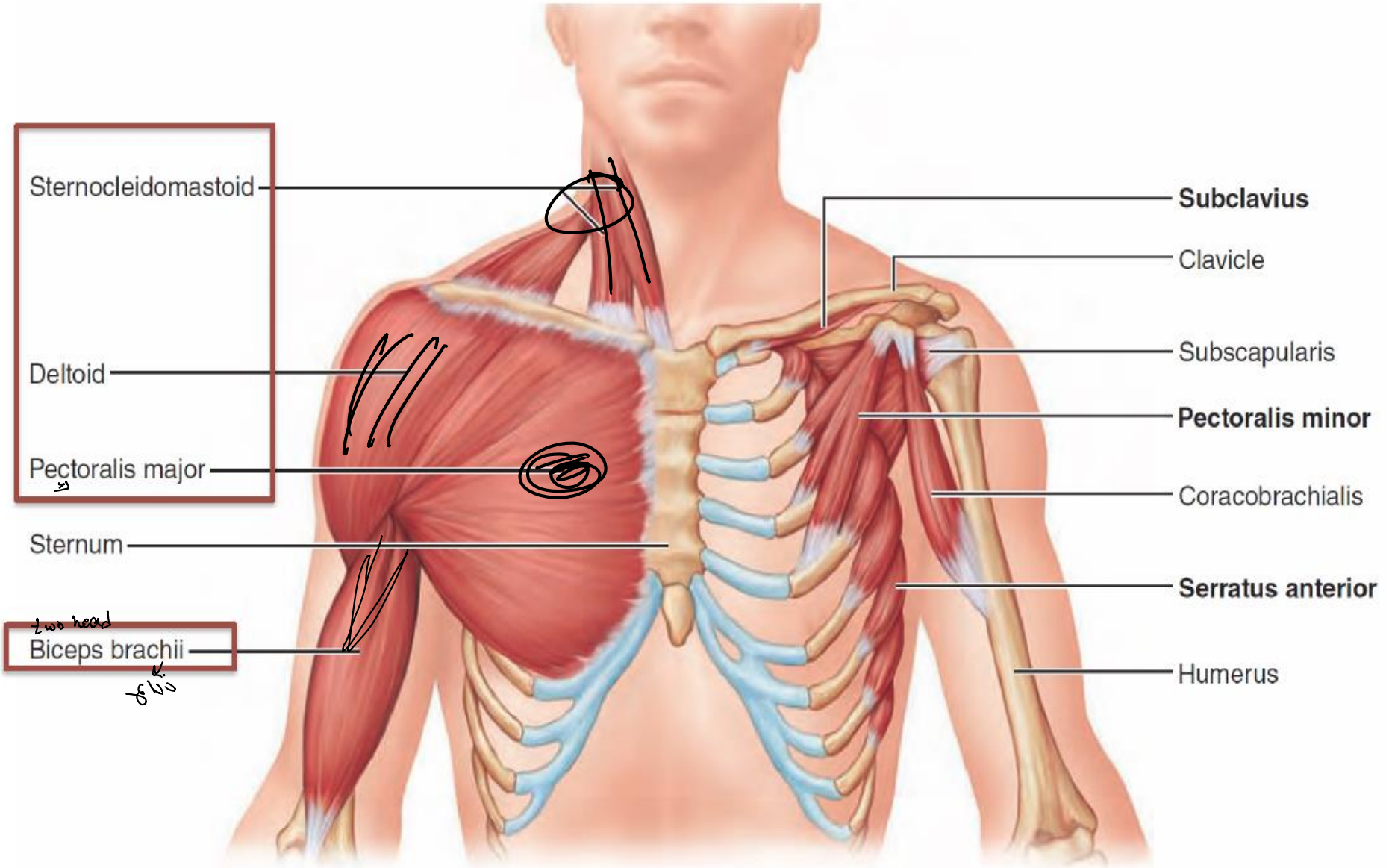


Example: Deltoid muscle (see Figure 11.10a)

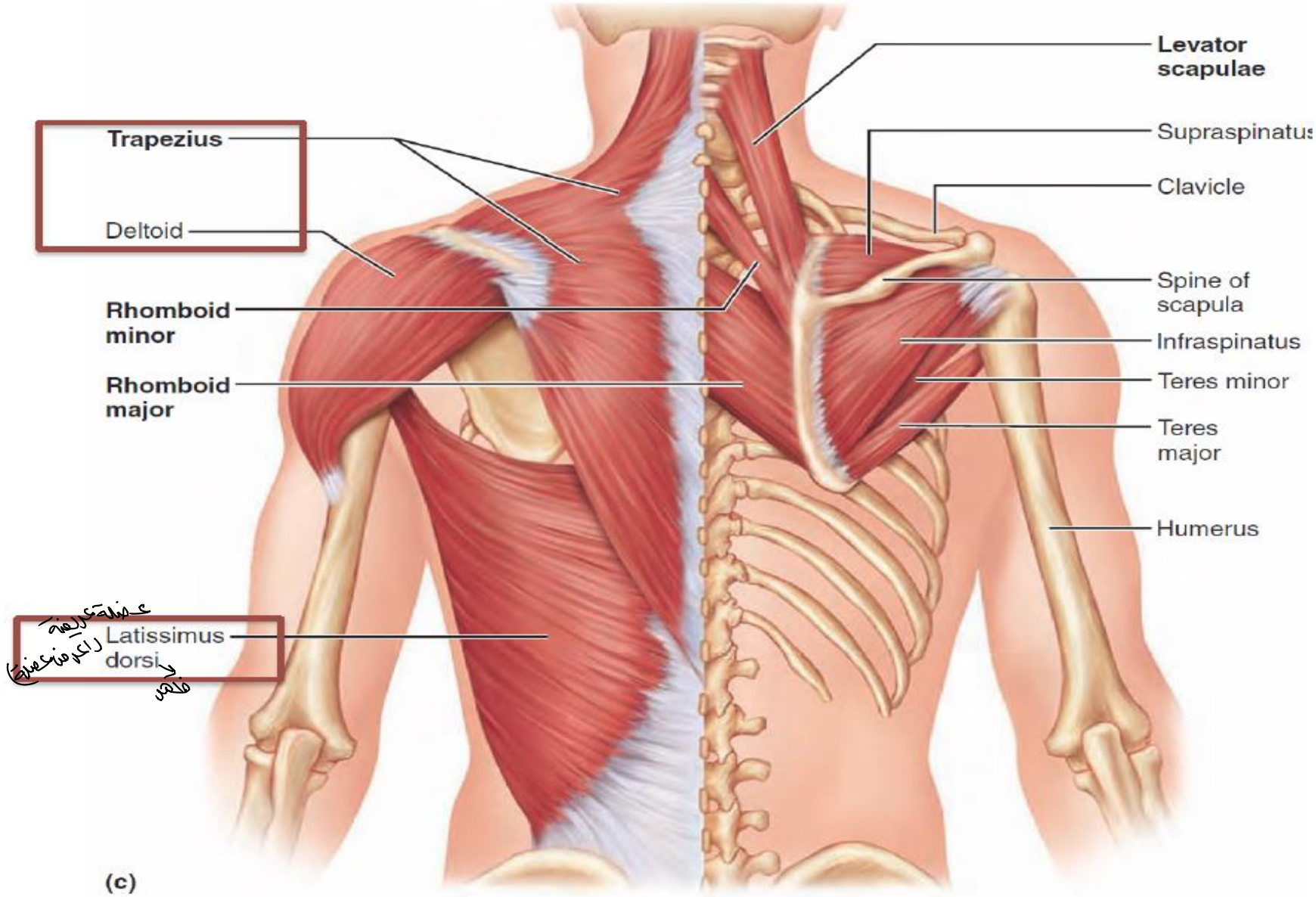
Head and Neck Muscles



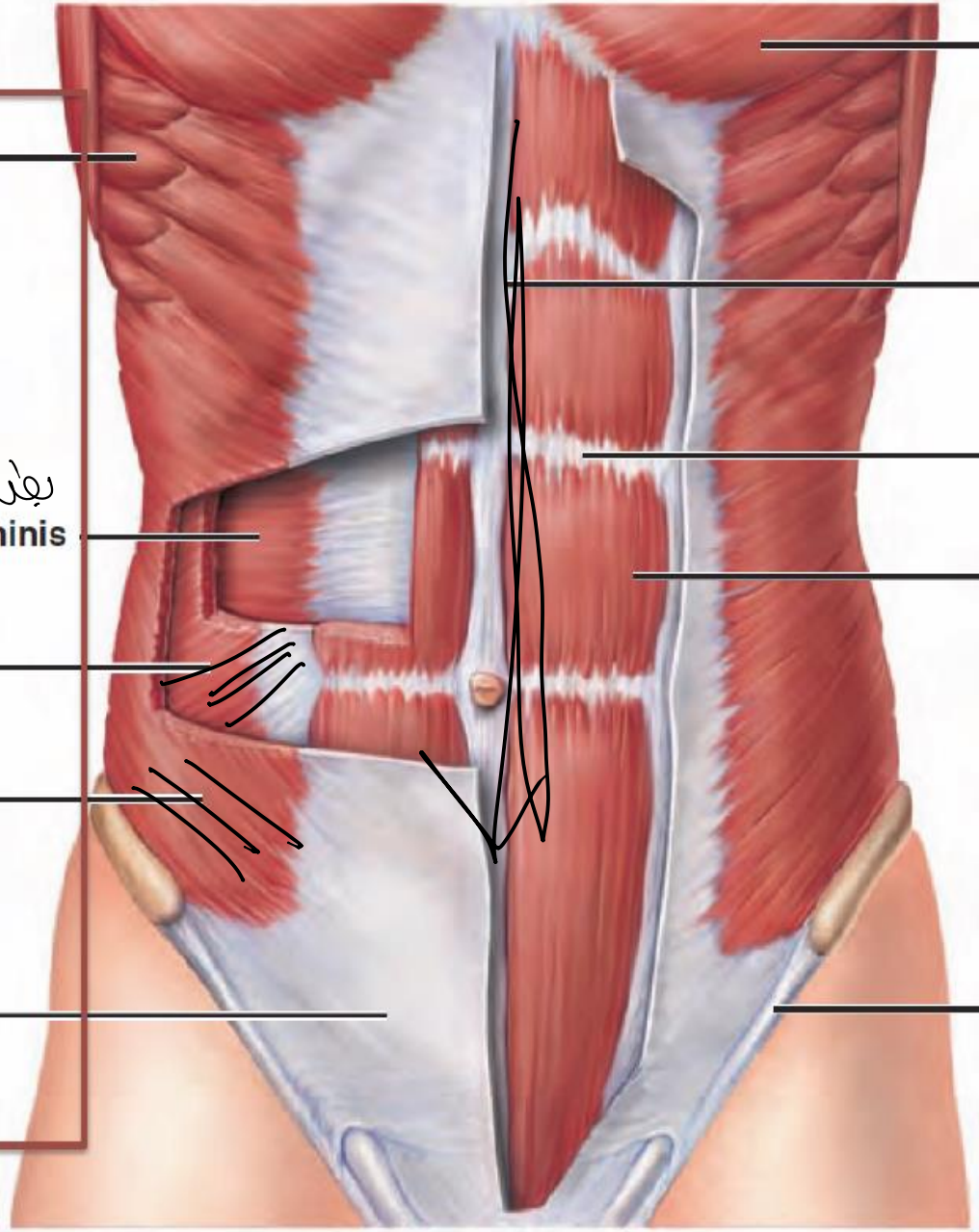
Superficial muscles of the thorax and shoulder acting on the scapula and arm



Superficial muscles of the thorax and shoulder acting on the scapula and arm



Trunk Muscles



Pectoralis major

Serratus anterior

Linea alba

Tendinous intersection

Transversus abdominis

Rectus abdominis

Internal oblique

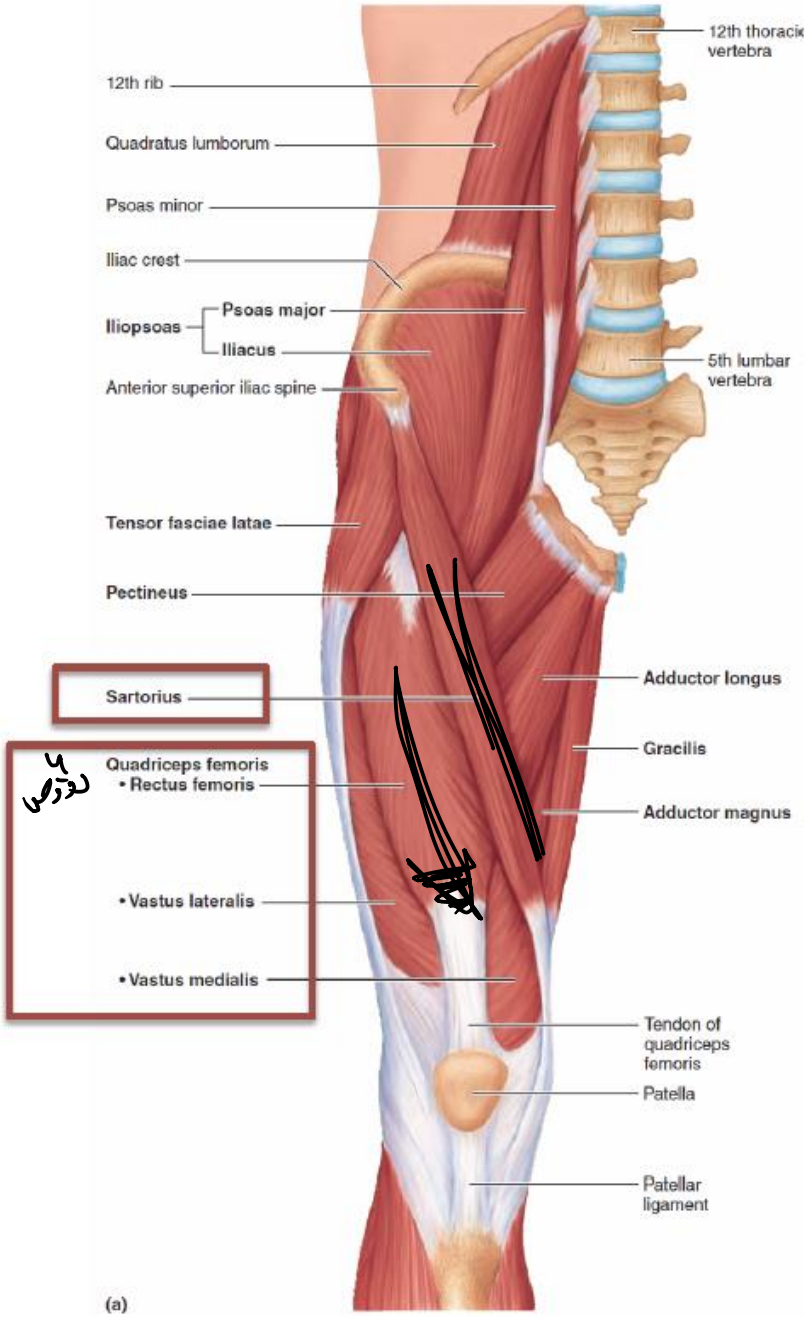
External oblique

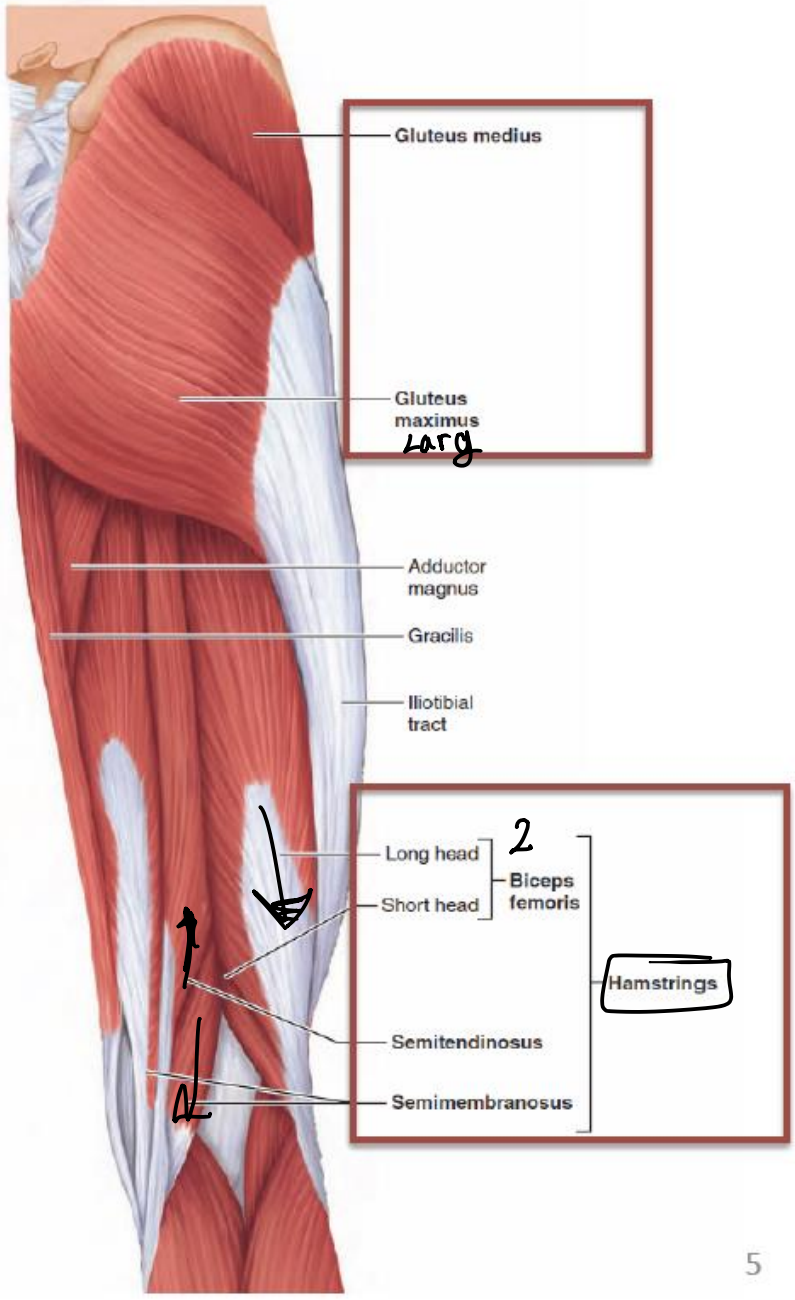
Aponeurosis of the external oblique

Inguinal ligament (formed by free inferior border of the external oblique aponeurosis)

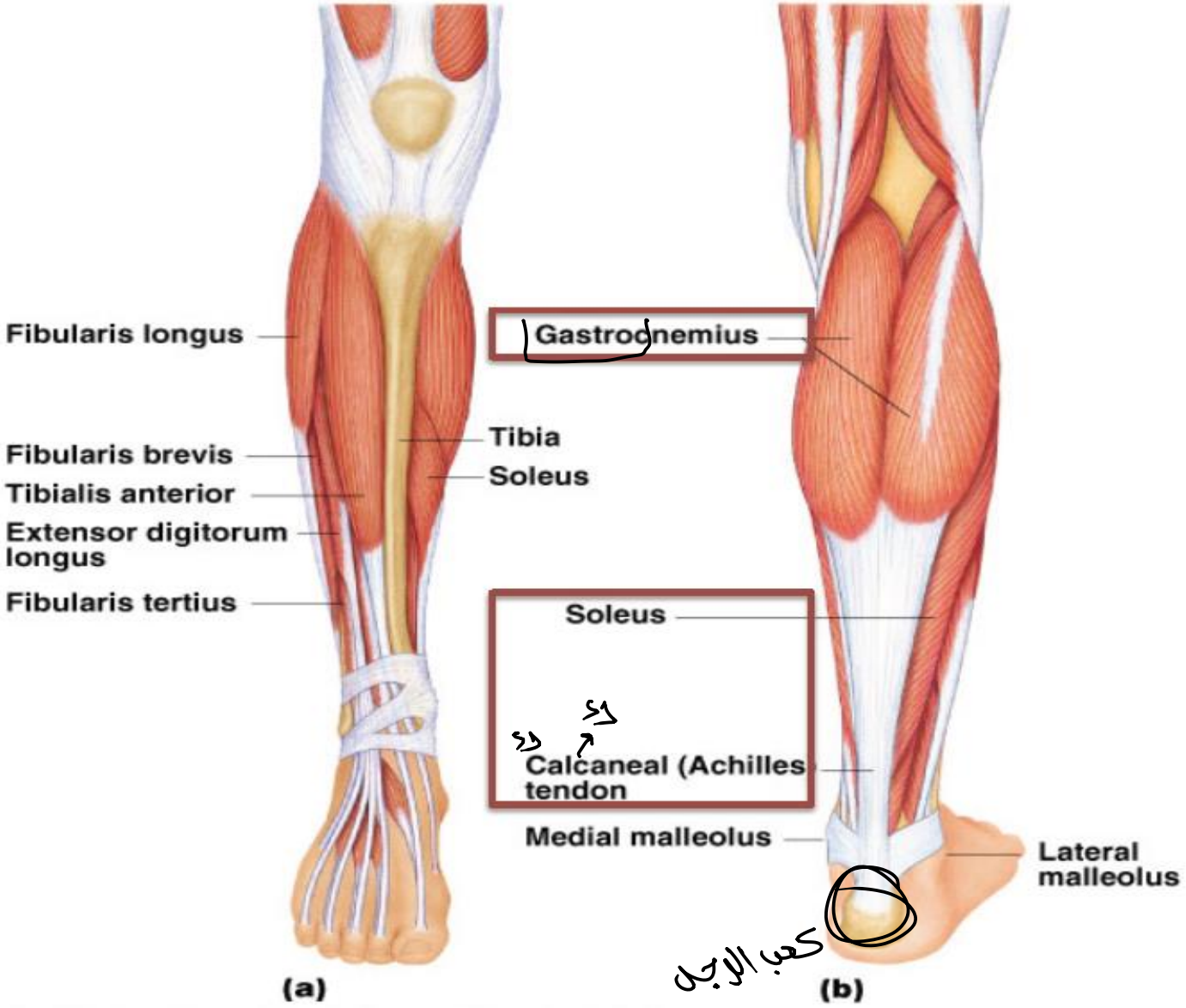
(a)

Muscles of the Pelvis, Hip, and Thigh

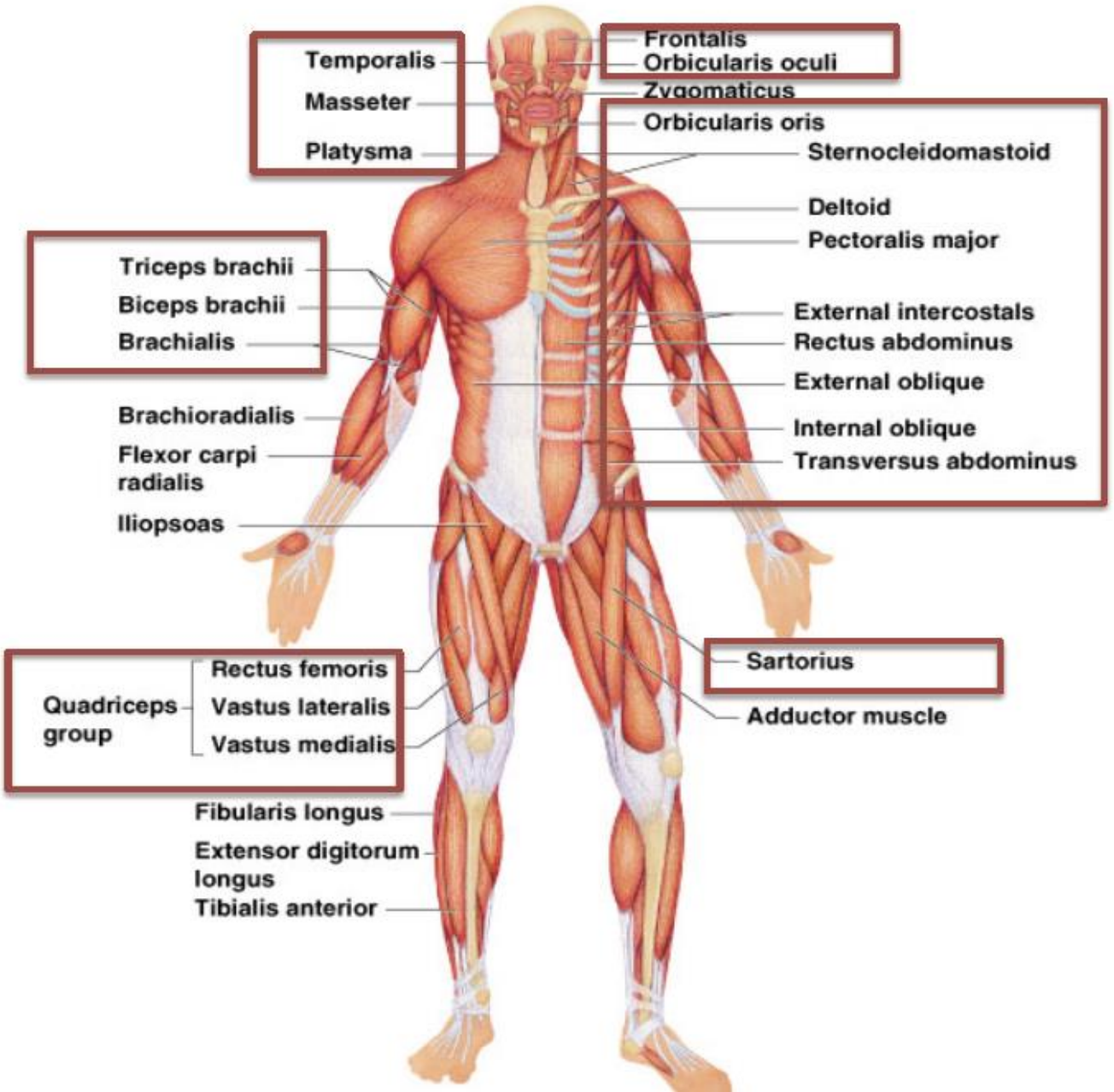




Muscles of the Lower Leg

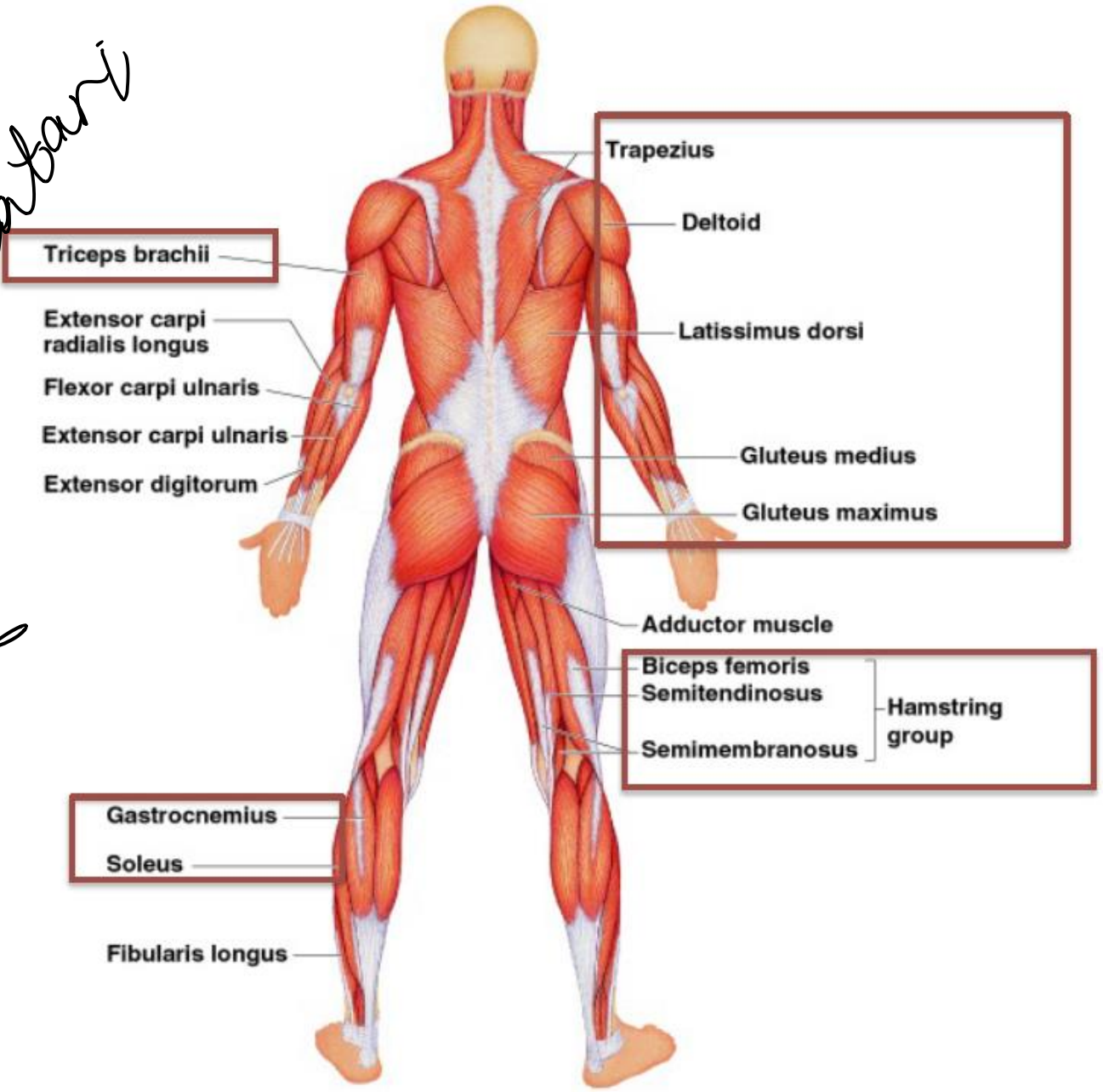


Superficial Muscles: Anterior



Superficial Muscles: Posterior

Sara Al Zabari



الله المستعان ♥

Chapter 5

Human Anatomy & Physiology

مهنس شراعي نما لا تشتهي ديحي .

Endocrine Systems

Leave and never come back.

Hamza Abu Hilail
M.Sc. Physiology

Sara Alzatari

مقارنة التحكم بواسطة الجهاز العصبي والغدد الصماء

Comparison of Control by the Nervous and Endocrine Systems

- The **nervous** and **endocrine** systems act together to coordinate all systems of the body.

- The nervous system releases **neurotransmitters**; the endocrine system releases **hormones**.

- Most hormones circulate through the blood and bind to receptors on **"target cells."**

- Neurotransmitters also bind to receptors on "target" cells.

الغدد الصماء

Endocrine Glands

- **Exocrine glands** secrete their products into ducts. None of these are hormones.

- These glands include **sudoriferous (sweat)** glands, **sebaceous (oil)** glands, **mucous** glands, **digestive** glands and several other throughout the body.

Endocrine Glands

- **Endocrine glands** secrete **hormones**. They do not have ducts and secrete their hormones directly into the **interstitial fluid** that surrounds them.

- The hormones **diffuse** into the blood stream through capillaries and are carried to **target cells** throughout the body.

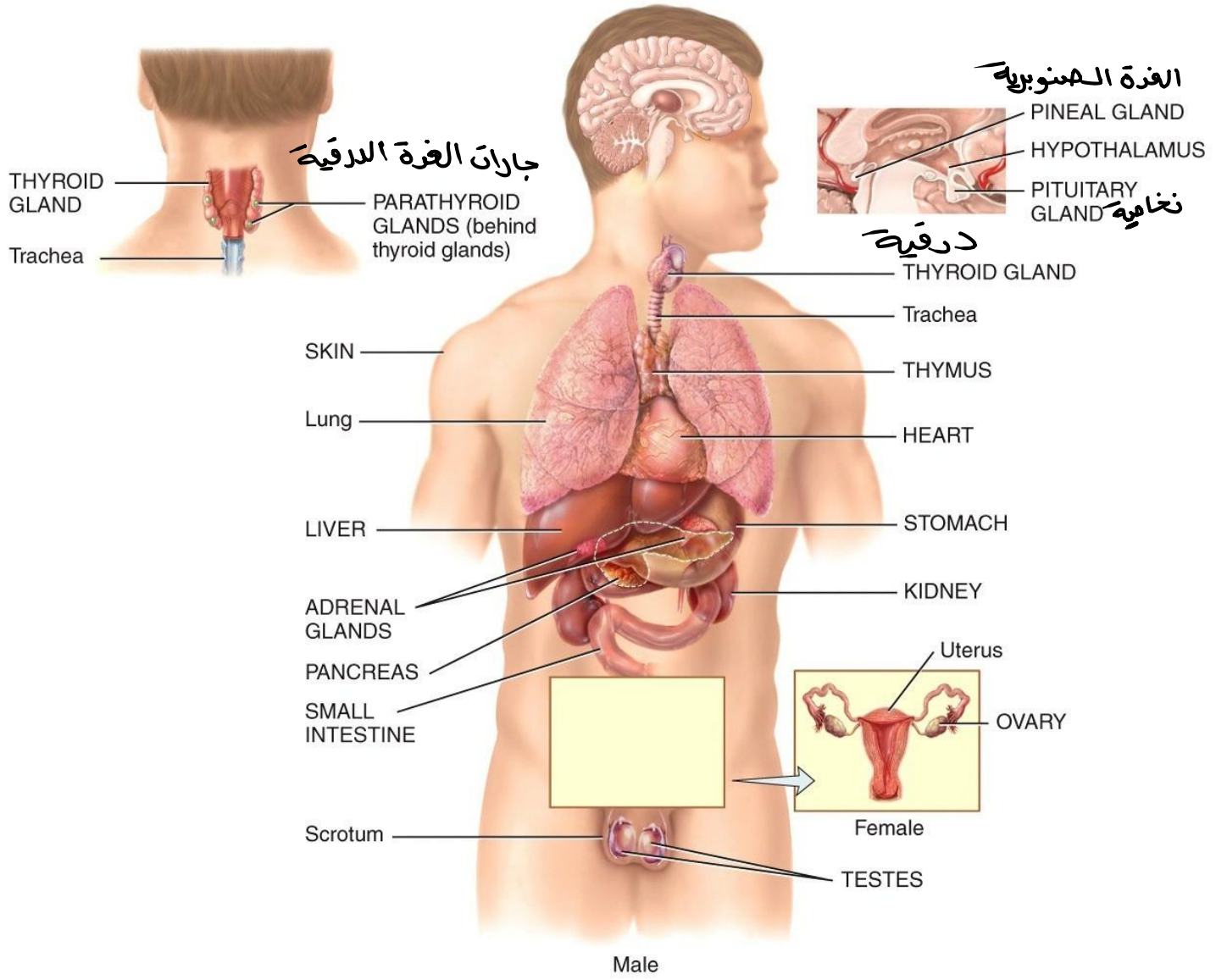
- Endocrine glands include the **pituitary**, **thyroid**, **parathyroid**, **adrenal & pineal glands**.

Endocrine Glands

- Several organs and tissues are not exclusively classified as endocrine glands but contain cells that secrete hormones. These include the **hypothalamus, thymus, pancreas, ovaries, testes, kidneys, stomach, liver, small intestine, skin, heart, adipose tissue, and placenta**.

✓ Taken together, all endocrine glands and hormone-secreting cells constitute the endocrine system

Endocrine Glands



Hormone Activity

الهرمونات التي تنتقل في جميع أنحاء الجسم ستؤثر فقط على

الخلايا المستهدفة التي تمتلك مستقبلات بروتينية محددة.

- Hormones traveling throughout the body will only affect **target cells** that possess specific **protein receptors**.

يتم تصنيع المستقبلات وكسرها باستمرار

- Receptors are continually being synthesized and broken down. تحت

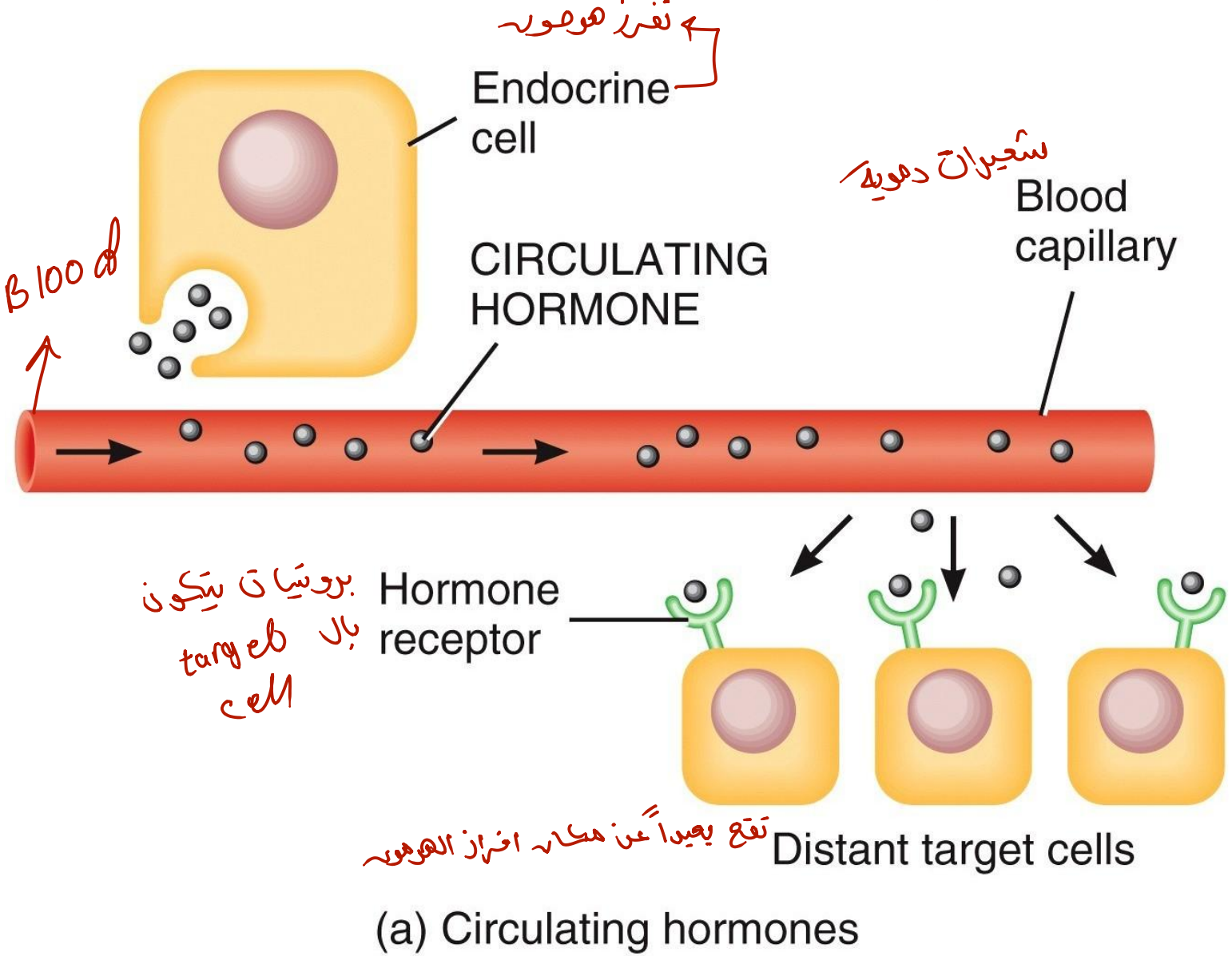
✓ Receptors may be **down-regulated** in the presence of high concentrations of hormone.

* إذا كانت كمية الهرمونات في الدم عالية لفترة طويلة
الـ Receptor ← نقلل عددها

✓ Receptors may be **up-regulated** in the presence of low concentrations of hormone.

* إذا كانت كمية الهرمونات قليلة
نهائي تزيد ← عدد الـ Receptor

Hormone Activity



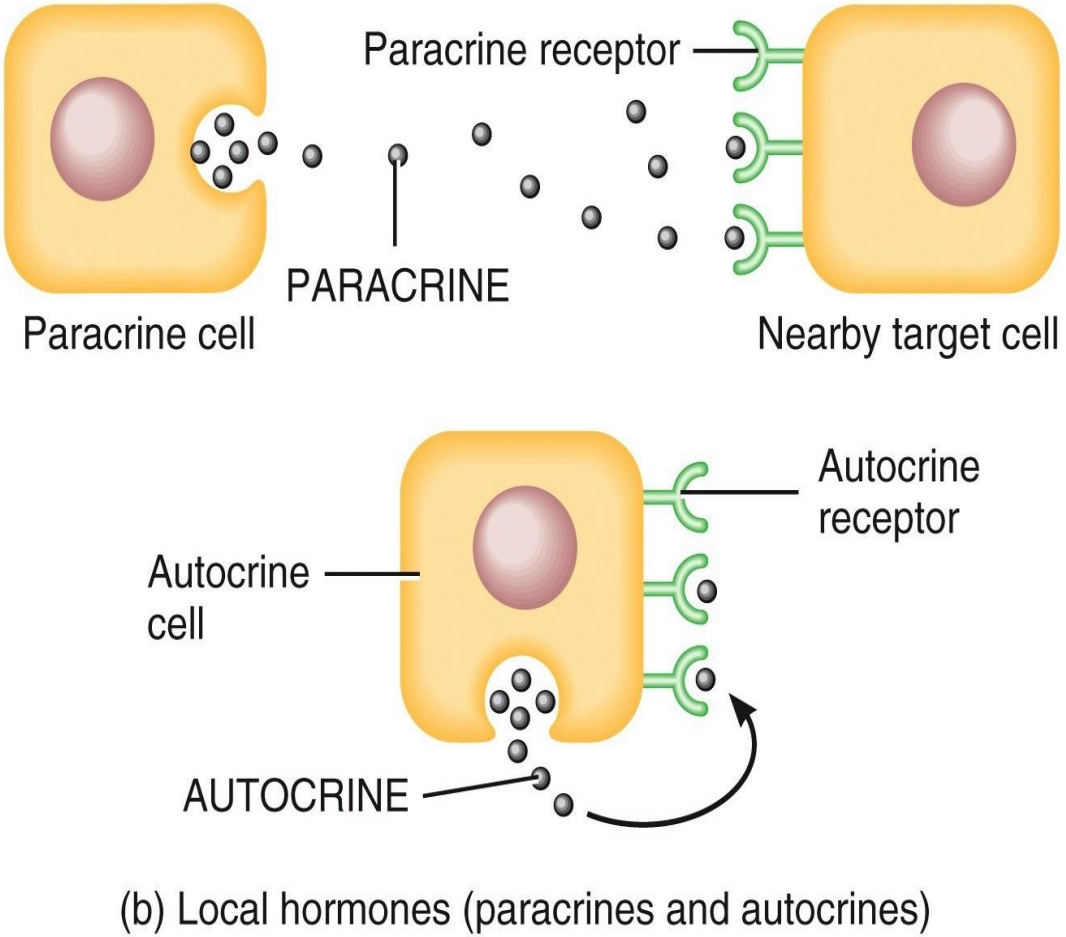
Hormone Activity

- Hormones that don't circulate are **local hormones (Paracrine).**

الهرمونات اللي لا تنتشر

- The hormones that act on the same cell that secretes them are called (**Autocrine**).

الهرمونات اللي تشتغل



Hormone Activity

- Hormones are either **lipid-soluble** (steroid hormones, thyroid hormones) or **water-soluble** (amine hormones, peptide and protein hormones).

- Water-soluble hormones circulate freely in the **plasma**.

- Lipid-soluble hormones circulate bound to **transport proteins**.

Mechanisms of Hormone Action

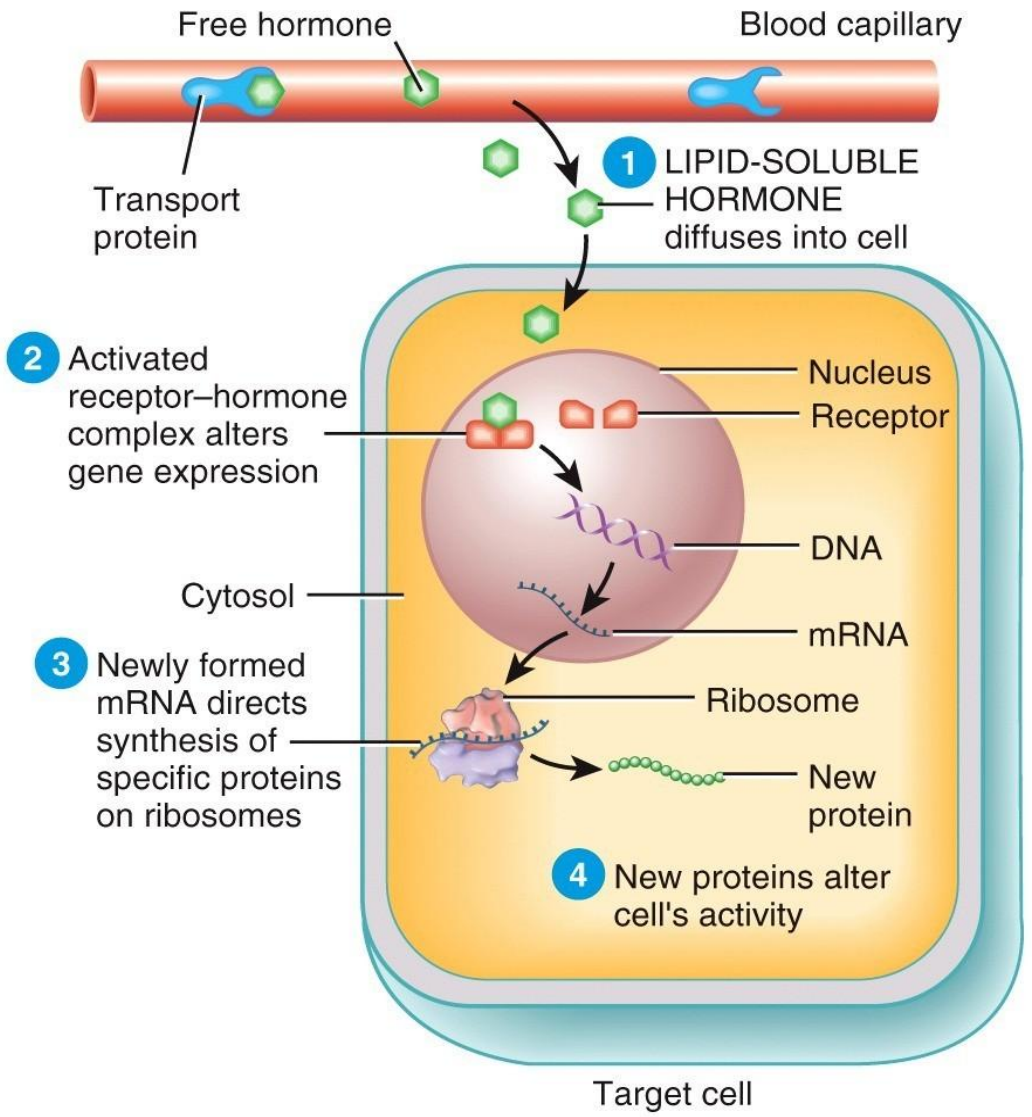
- Responses to the same hormone may vary depending on the hormone itself and the target cell.

قد تختلف الاستجابات لنفس الهرمون اعتمادا على الهرمون نفسه والخلية المستهدفة.

- The response may be:
  - Synthesis of new molecules
  - Changing permeability of the cell membrane
  - Stimulating transport of a substance into or out of the cell
  - Altering the rate of metabolic actions
  - Causing contraction of smooth or cardiac muscle

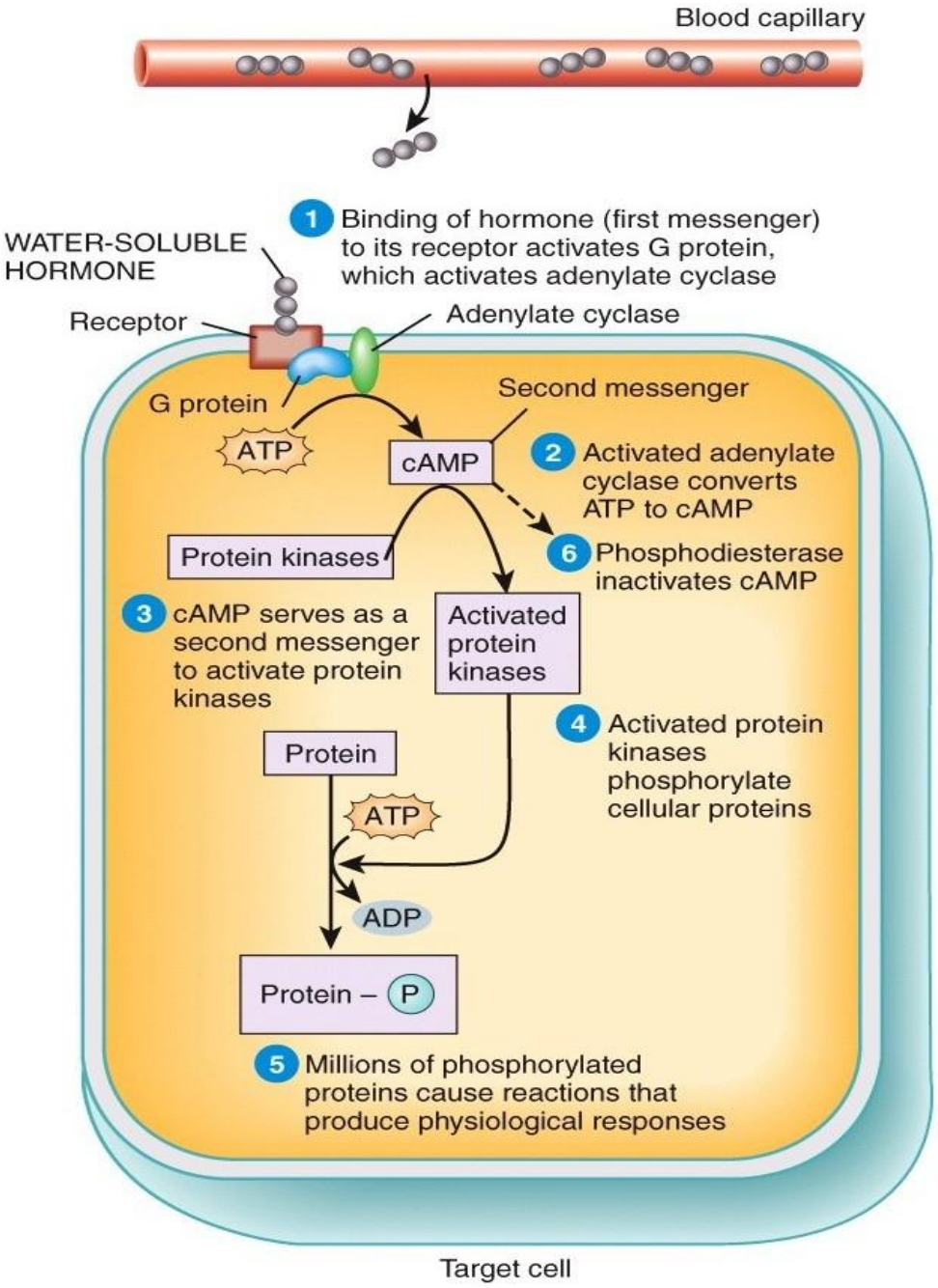
Mechanisms of Hormone Action

Lipid-soluble hormones bind to receptors within target cells.



Mechanisms of Hormone Action

Water-soluble hormones bind to receptors on the exterior surface of the target cell.



التحكم في إفراز الهرمونات

Control of Hormone Secretion

فترات قصيرة

Hormones are secreted in short bursts when needed.

يتم تنظيم الإفراز بواسطة:

Secretion is regulated by:

TSH

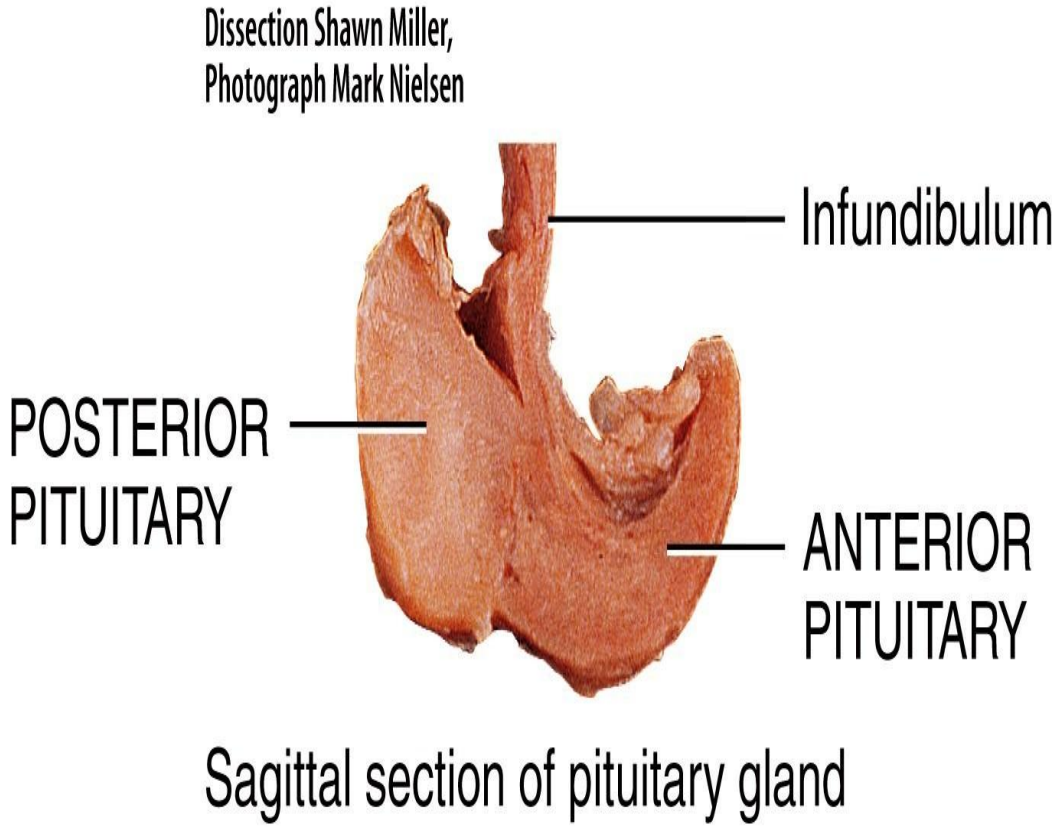
- Signals from the nervous system
- Chemical changes in the blood
- Other hormones

- إشارات من الجهاز العصبي
- التغيرات الكيميائية في الدم
- هرمونات أخرى

تحت المهاد والغدة النخامية

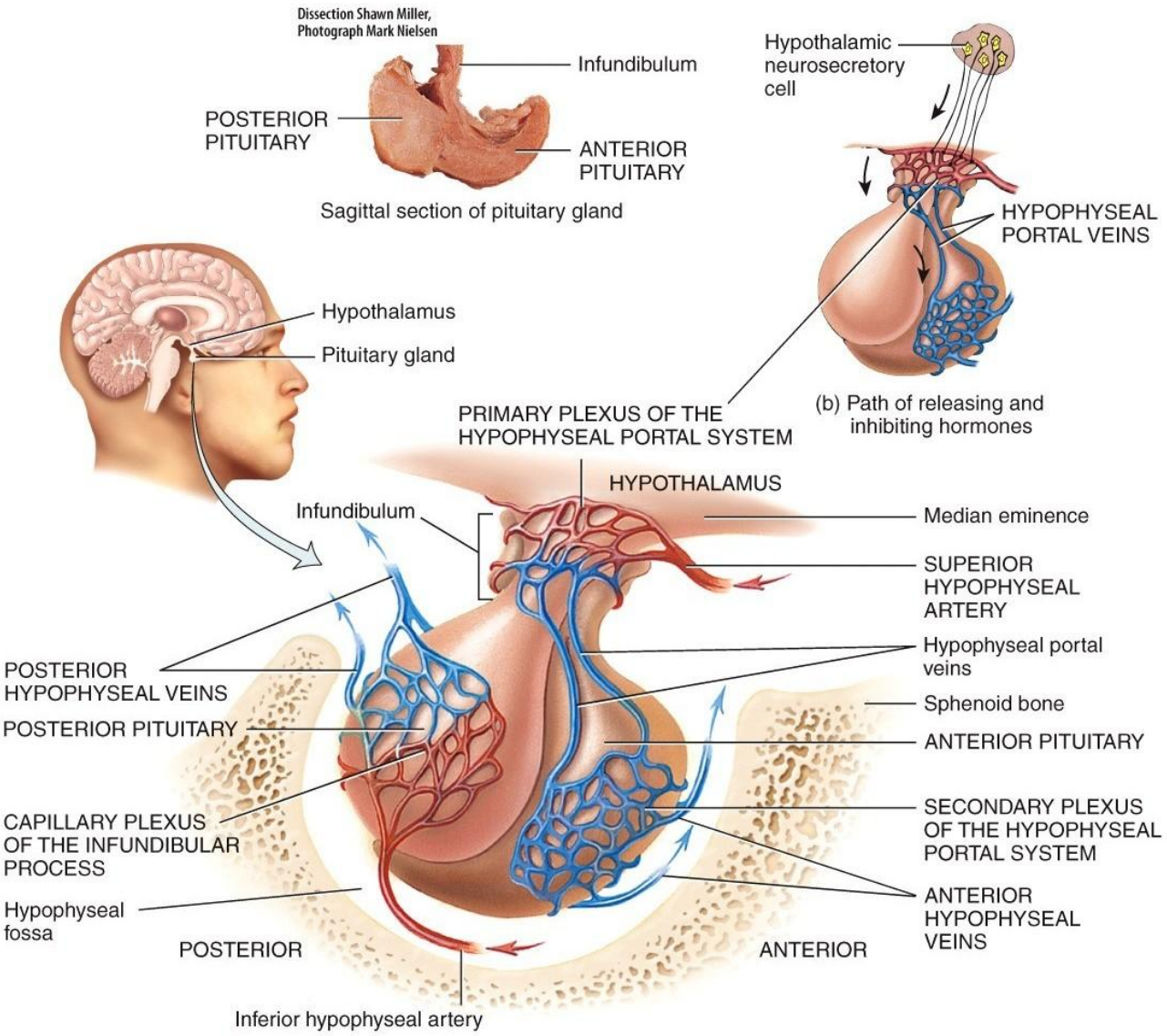
Hypothalamus and Pituitary Gland

- The **hypothalamus** and **pituitary gland** work together to control other endocrine glands. They are connected by the **infundibulum**.



يعمل الوطاء (الهايبوثلاموس) والغدة النخامية معًا للسيطرة على الغدد الصماء الأخرى. وهما متصلان بواسطة القمع (الإنفوندِيبولوم)

Hypothalamus and Pituitary Gland



Hypothalamus and Pituitary Gland

- The **anterior lobe (adenohypophysis)** makes up 75% of the weight of the pituitary gland and secretes **7 hormones**.

يشكل الفص الأمامي (الغدة النخامية الغدية) 75٪

من وزن الغدة النخامية ويفرز 7 هرمونات

- The **posterior lobe (neurohypophysis)** is made of neural tissue and releases two hormones made by the **hypothalamus**.

يتكون الفص الخلفي (الغدة النخامية العصبية) من

الأنسجة العصبية وتطلق هرمونين يصنعهما

تحت المهاد

- The **hypothalamus** secretes **releasing** and **inhibiting hormones** that control the release of hormones by the pituitary gland. They reach the pituitary gland via the **hypophyseal portal system**.

يفرز تحت المهاد إطلاقا وتثبيطا

الهرمونات التي تتحكم في إطلاق الهرمونات بواسطة

الغدة النخامية. يصلون إلى الغدة النخامية عن طريق

نظام بوابة الغدة النخامية.

Hypothalamus and Pituitary Gland

- The anterior pituitary gland secretes 7 hormones produced by 5 different types of cells.

TABLE 18.3

Hormones of the Anterior Pituitary

HORMONE	SECRETED BY	HYPOTHALAMIC RELEASING HORMONE (STIMULATES SECRETION)	HYPOTHALAMIC INHIBITING HORMONE (SUPPRESSES SECRETION)
Human growth hormone (hGH), also known as somatotropin	Somatotrophs. 1	Growth hormone–releasing hormone (GHRH), also known as somatocrinin.	Growth hormone–inhibiting hormone (GHIH), also known as somatostatin.
Thyroid-stimulating hormone (TSH), also known as thyrotropin	Thyrotrophs. 2	Thyrotropin-releasing hormone (TRH).	Growth hormone–inhibiting hormone (GHIH).
Follicle-stimulating hormone (FSH)	Gonadotrophs. 3	Gonadotropin-releasing hormone (GnRH).	—
Luteinizing hormone (LH)	Gonadotrophs. 4	Gonadotropin-releasing hormone (GnRH).	—
Prolactin (PRL)	Lactotrophs. 5	Prolactin-releasing hormone (PRH).*	Prolactin-inhibiting hormone (PIH), which is dopamine.
Adrenocorticotropic hormone (ACTH), also known as corticotropin	Corticotrophs. 6	Corticotropin-releasing hormone (CRH).	—
Melanocyte-stimulating hormone (MSH)	Corticotrophs. 7	Corticotropin-releasing hormone (CRH).	Dopamine.

*Thought to exist, but exact nature is uncertain.

Hypothalamus and Pituitary Gland

هرمون النمو البشري (hGH) هو الأكثر وفرة

هرمون الغدة النخامية الأمامية

- **Human growth hormone (hGH)** is the most plentiful anterior pituitary hormone.

- It is released in bursts every few hours by **somatotrophs**.

يتم إفرازه في دفعات كل بضع ساعات بواسطة الخلايا السوماتوتروفية.

- Their activity is controlled by two hypothalamic hormones: **growth hormone-releasing hormone (GHRH) and growth hormone-inhibiting hormone (GHIH)**.

يتم التحكم في نشاطهم عن طريق اثنين من ما تحت المهاد

الهرمونات: هرمون إفراز هرمون النمو

وهرمون تثبيط هرمون النمو (GHRH)

(غيه).

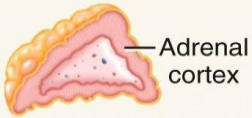
Hypothalamus and Pituitary Gland

- In summary, the anterior pituitary gland secretes:

1. human growth hormone **(hGH)**
2 thyroid-stimulating hormone **(TSH)**
3. follicle-stimulating hormone **(FSH)**
4. luteinizing hormone **(LH)**
5. prolactin **(PRL)**
6. adrenocorticotropic hormone **(ACTH)**
7. melanocyte-stimulating hormone **(MSH).**

TABLE 18.4

Summary of the Principal Actions of Anterior Pituitary Hormones

HORMONE	TARGET TISSUES	PRINCIPAL ACTIONS
Human growth hormone (hGH), also known as somatotropin	 Liver (and other tissues)	Stimulates liver, muscle, cartilage, bone, and other tissues to synthesize and secrete insulinlike growth factors (IGFs); IGFs promote growth of body cells, protein synthesis, tissue repair, lipolysis, and elevation of blood glucose concentration.
Thyroid-stimulating hormone (TSH), also known as thyrotropin	 Thyroid gland	Stimulates synthesis and secretion of thyroid hormones by thyroid gland.
Follicle-stimulating hormone (FSH)	 Ovary Testis	In females, initiates development of oocytes and induces ovarian secretion of estrogens. In males, stimulates testes to produce sperm.
Luteinizing hormone (LH)	 Ovary Testis	In females, stimulates secretion of estrogens and progesterone, ovulation, and formation of corpus luteum. In males, stimulates testes to produce testosterone.
Prolactin (PRL)	 Mammary glands	Together with other hormones, promotes milk production by mammary glands.
Adrenocorticotropic hormone (ACTH), also known as corticotropin		Stimulates secretion of glucocorticoids (mainly cortisol) by adrenal cortex.
Melanocyte-stimulating hormone (MSH)	 Brain	Exact role in humans is unknown but may influence brain activity; when present in excess, can cause darkening of skin.

Hypothalamus and Pituitary Gland

الغدة النخامية الخلفية لا

توليف أي هرمونات، ولكن يخزن ويطلق

من أطراف محور عصبي اثنين من الهرمونات التي تنتجها

الخلايا العصبية الإفرازية في منطقة ما تحت المهاد:

- The **posterior pituitary gland** does not synthesize any hormones, but stores and releases from axon terminals two hormones produced by the **neurosecretory cells** of the hypothalamus:

1. **Oxytocin (OT)**
2. **Anti- diuretic hormone (ADH)**.

هرمون مضاد لمدرات البول

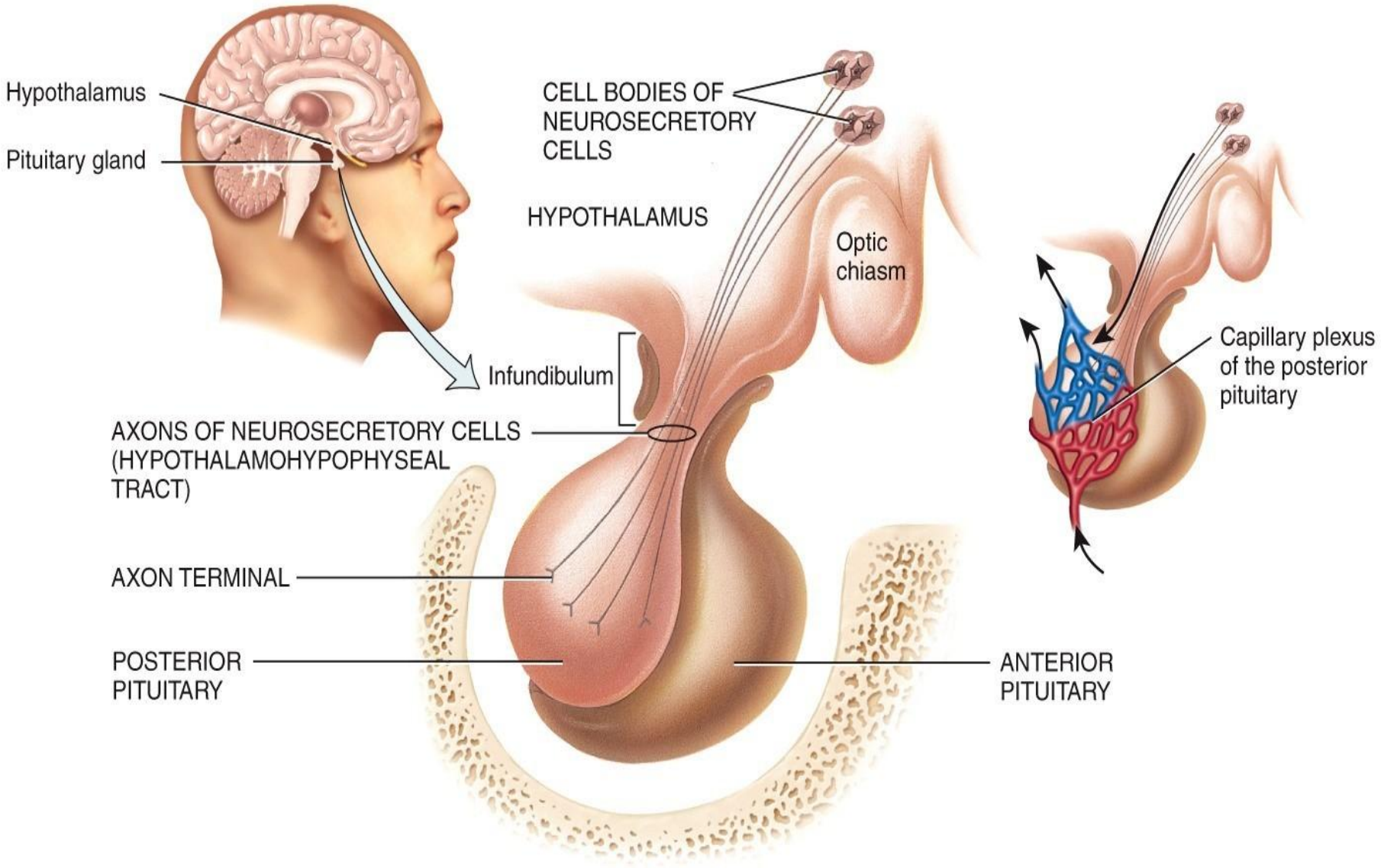
تحت المهاد

- Axons from the neurosecretory cells form the **hypothalamohypophyseal tract**.

تشكل المحاور من الخلايا العصبية الإفرازية

الجهاز تحت المهاد.

Hypothalamus and Pituitary Gland



Hypothalamus and Pituitary Gland

- The amount of **antidiuretic hormone (ADH)** secreted varies with blood osmotic pressure. Its function is to decrease urine output.

كمية الهرمون المضاد لإدرار البول (ADH) المفرز

يختلف مع الضغط التناضحي للدم. وظيفتها هي

تقليل إنتاج البول.

- **Osmoreceptors** (neurons) in the hypothalamus monitor blood osmotic pressure.

المستقبلات التناضحية (الخلايا العصبية) في جهاز مراقبة منطقة ما تحت المهاد

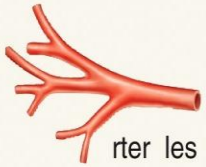
الضغط التناضحي للدم

- ✓ An increase in blood volume causes a decrease in ADH secretion.
- ✓ A decrease in blood volume causes an increase in ADH secretion.

Hypothalamus and Pituitary Gland

TABLE 18.5

Summary of Posterior Pituitary Hormones

HORMONE AND TARGET TISSUES	CONTROL OF SECRETION	PRINCIPAL ACTIONS
Oxytocin (OT)  Uterus  Mammary glands	Neurosecretory cells of hypothalamus secrete OT in response to uterine distension and stimulation of nipples.	Stimulates contraction of smooth muscle cells of uterus during childbirth; stimulates contraction of myoepithelial cells in mammary glands to cause milk ejection.
Antidiuretic hormone (ADH) or vasopressin  dneys  ud r er us s eat glands  rter les	Neurosecretory cells of hypothalamus secrete ADH in response to elevated blood osmotic pressure, dehydration, loss of blood volume, pain, or stress; inhibitors of ADH secretion include low blood osmotic pressure, high blood volume, and alcohol.	Conserves body water by decreasing urine volume; decreases water loss through perspiration; raises blood pressure by constricting arterioles.

الغدة الدرقية

Thyroid Gland

- The **thyroid gland** is a butterfly-shaped gland located inferior to the larynx and anterior to the trachea.

أسفل الحنجرة

أمام القصبة الهوائية

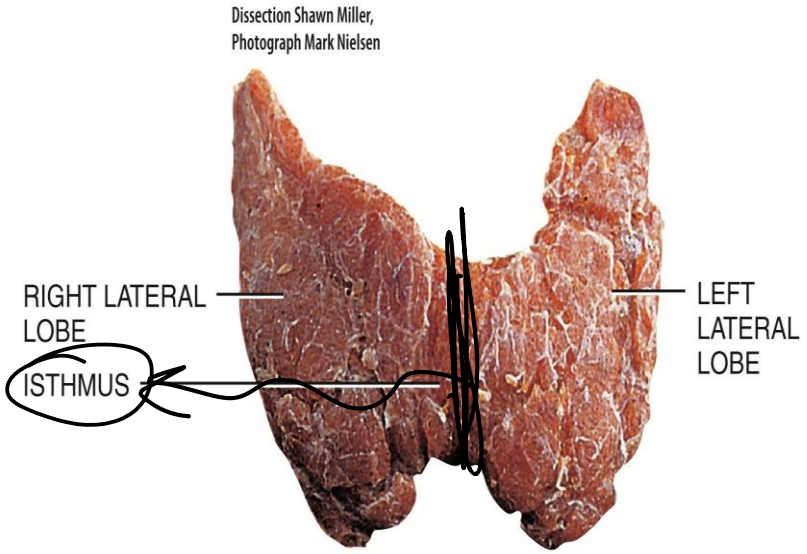
- It has **right and left lateral lobes connected by an isthmus**.

لديها يمين ويسار جانبي

فصوص متصلة بواسطة

برزخ.

- Some glands also have a **pyramidal lobe** projecting from the isthmus.



(c) Anterior view of thyroid gland

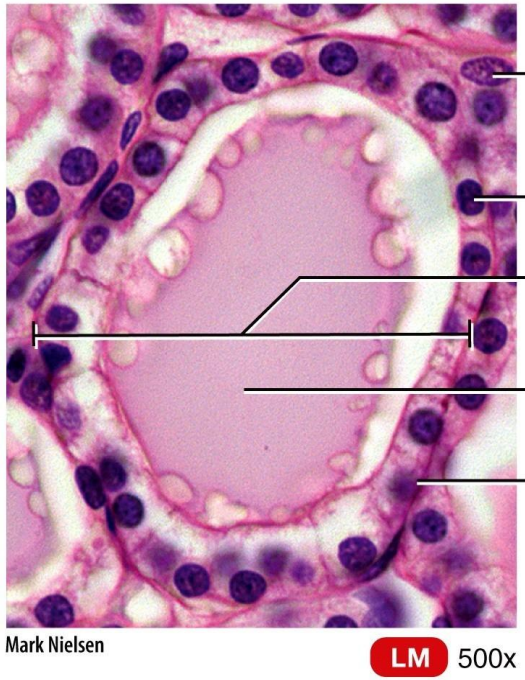
Samar Alzatari

Thyroid Gland

الخلايا

1. **Follicular cells** are stimulated by **TSH** (thyroid-stimulating hormone) to produce **thyroxine** (**tetraiodothyronine**, **T4**) and (**triiodothyronine**, **T3**) known as **thyroid hormones**.

2. **Parafollicular cells** produce the hormone **calcitonin** to help regulate calcium homeostasis.



(b) Thyroid follicles

الخلايا الجريبية هي

يحفزه TSH إلى

إنتاج هرمون الغدة الدرقية

(رباعي يودوثيرونين، T4)

و(ثلاثي يودوثيرونين، T3)

تعرف باسم الغدة الدرقية

هرمونات

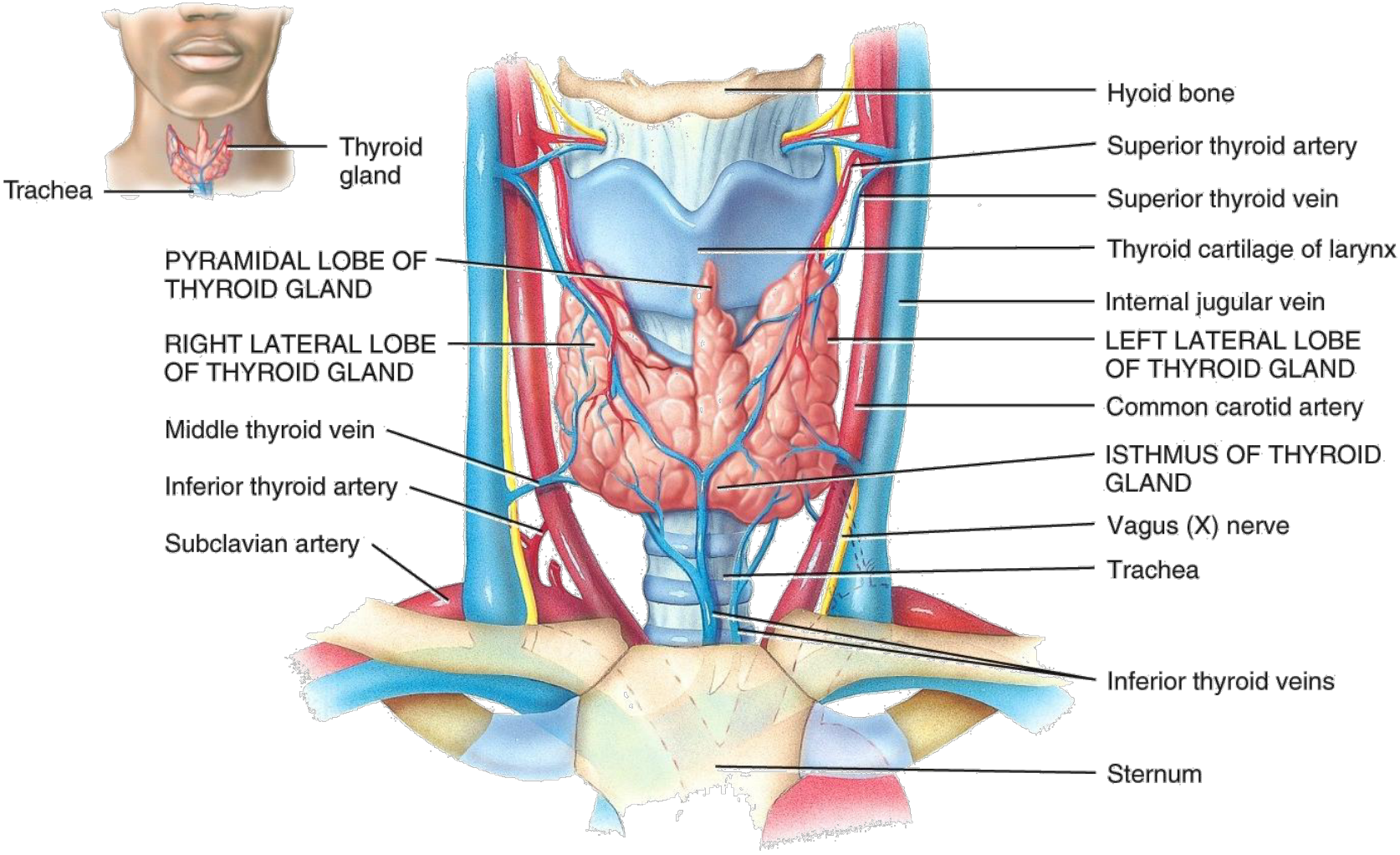
الخلايا شبه الجريبية

ينتج الهرمون

الكالسيتونين للمساعدة في التنظيم

توازن الكالسيوم.

Thyroid Gland



(a) Anterior view of thyroid gland

Thyroid Gland

هرمونات الغدة الدرقية

Thyroid hormones:

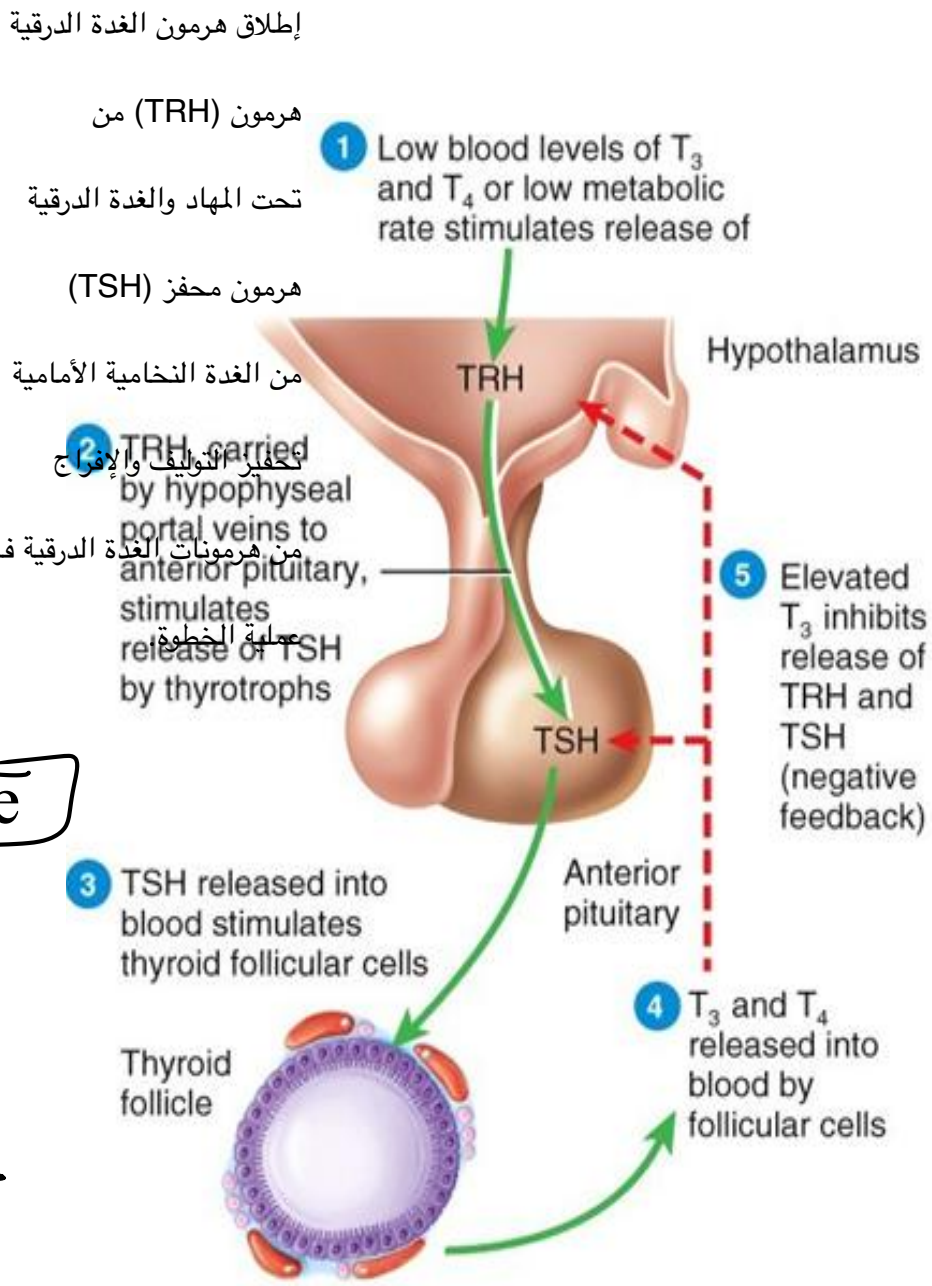
- Increase **basal metabolic rate (BMR)**
- Help maintain normal body temperature
- Stimulate protein synthesis
- Increase the use of glucose and fatty acids for ATP production
- Work with hGH and insulin to accelerate body growth

- زيادة معدل الأيض القاعدي (BMR)
- يساعد في الحفاظ على درجة حرارة الجسم الطبيعية
- تحفيز تخليق البروتين
- زيادة استخدام الجلوكوز والأحماض الدهنية ل ATP إنتاج
- العمل مع هرمون النمو والأنسولين لتسريع نمو الجسم

Thyroid Gland

- **Thyrotropin-releasing hormone (TRH)** from the hypothalamus and **thyroid stimulating hormone (TSH)** from the anterior pituitary stimulate synthesis and release of thyroid hormones in a 5 step process.

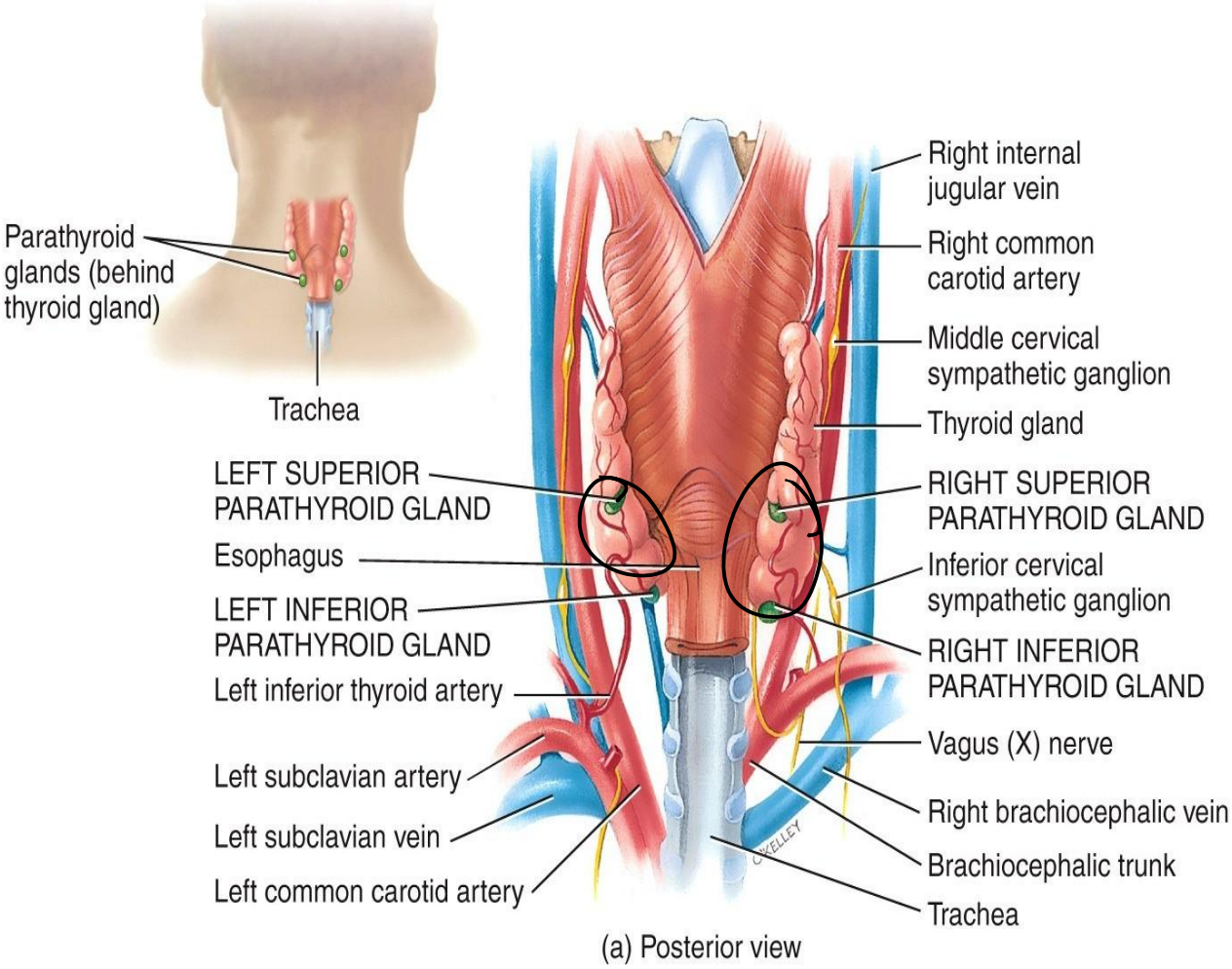
- **(TRH) → (TSH) → T3&T4**



Parathyroid Glands

الغدد الدرقية

Located on the posterior aspect of each lobe of the thyroid gland are 2 **parathyroid glands** (one inferior and one superior).



Parathyroid Glands

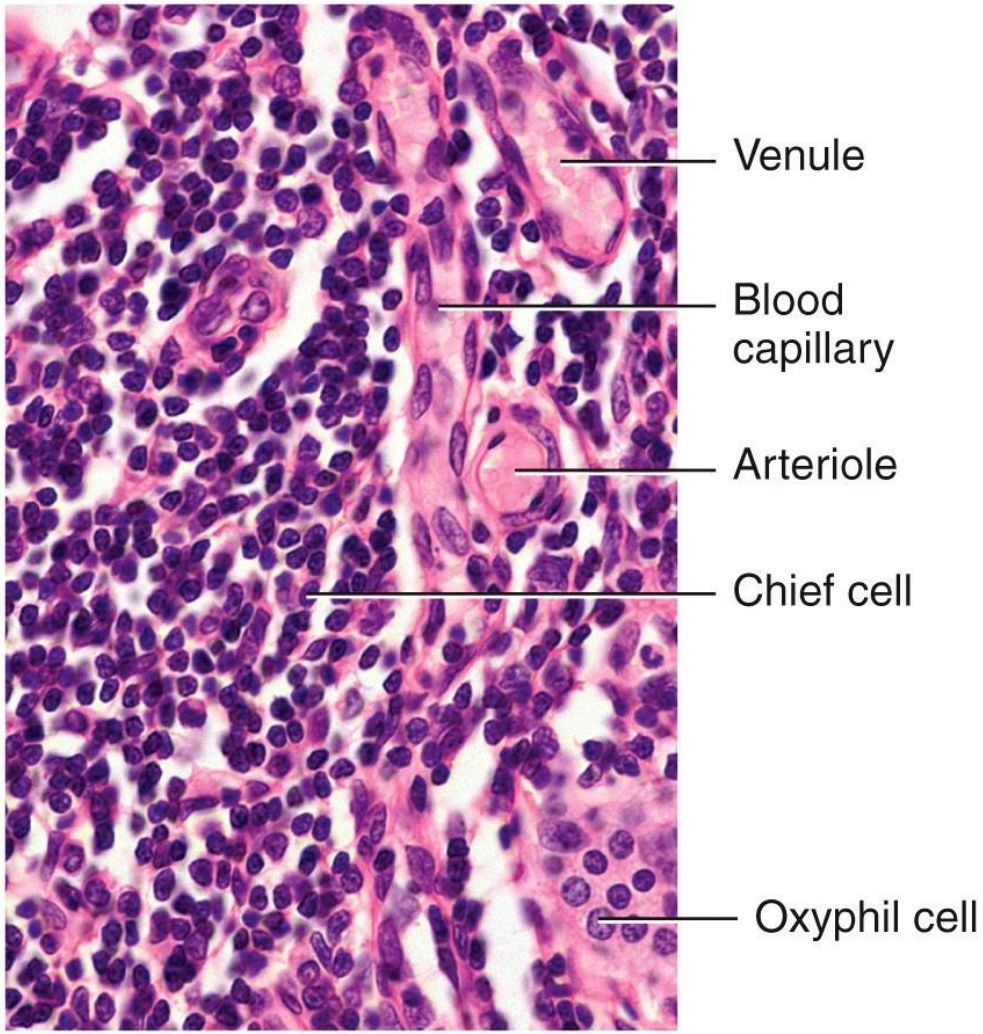
- Parathyroid glands contain 2 types of cells:

1. **Chief cells (principal cells)** that produce **parathyroid hormone (PTH)**

الخلايا الرئيسية

2. **Oxyphil cells** whose function is not known in normal parathyroid glands but which secrete excess PTH in cases of parathyroid cancer

Parathyroid Glands

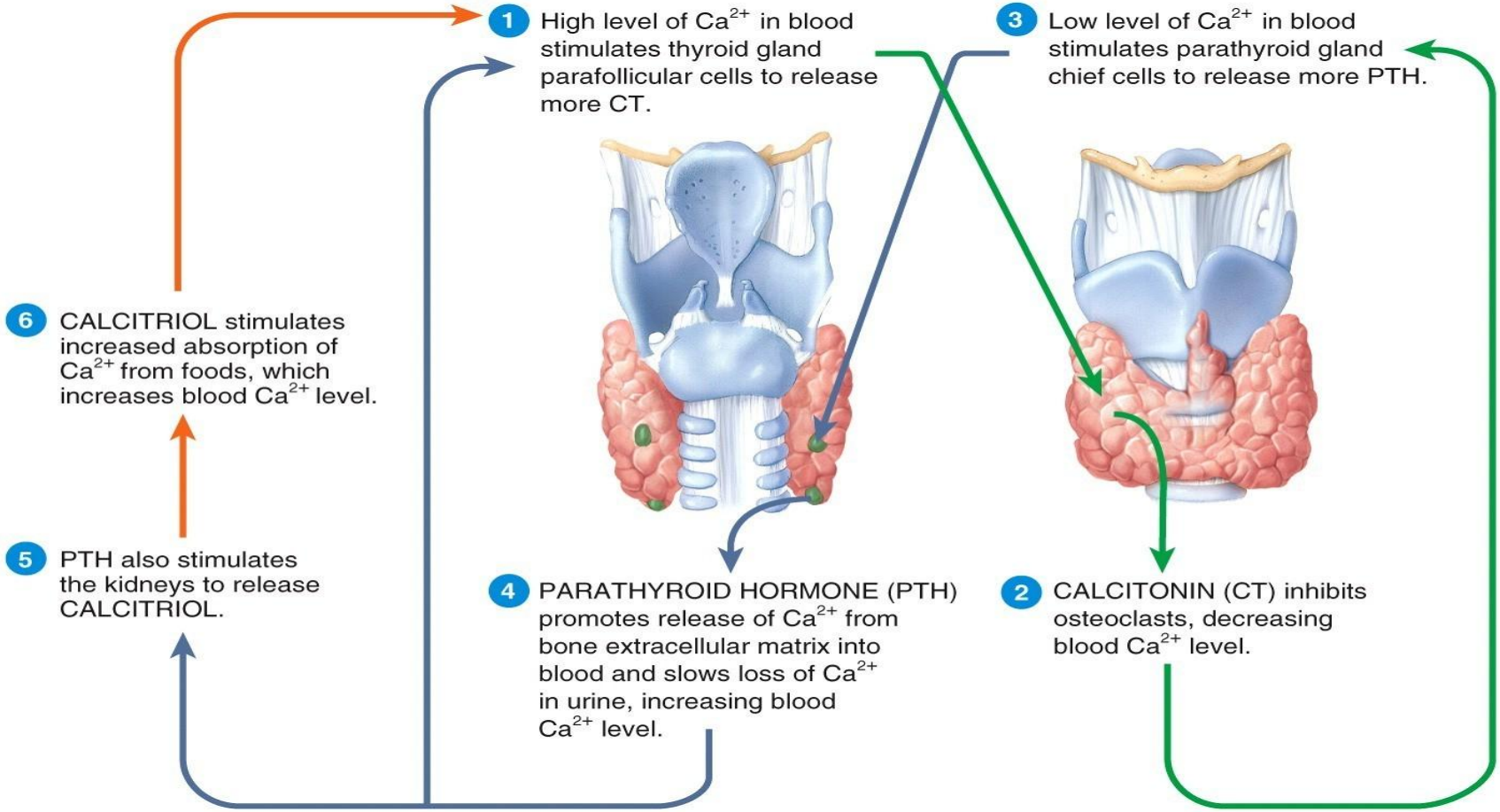


(b) Parathyroid gland

Parathyroid Glands

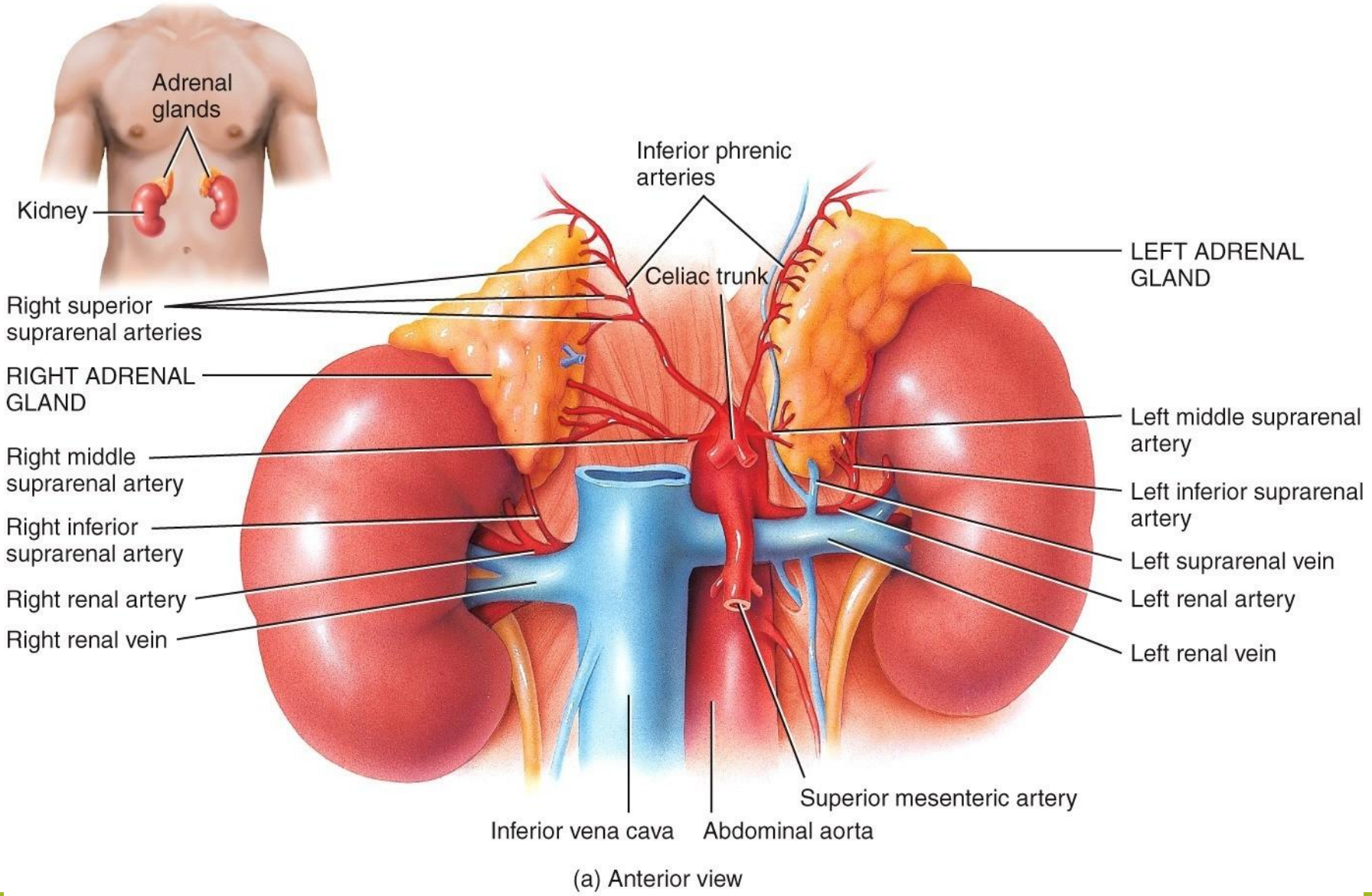
يعمل الكالسيتونين الذي تنتجه الغدة الدرقية بالتزامن مع PTH والكالسيتريول لتنظيم توازن الكالسيوم.

Calcitonin produced by the thyroid gland works in conjunction with **PTH** and **calcitriol** to regulate calcium homeostasis.



Adrenal Glands

الغدد الكظرية



الغدد الكظرية

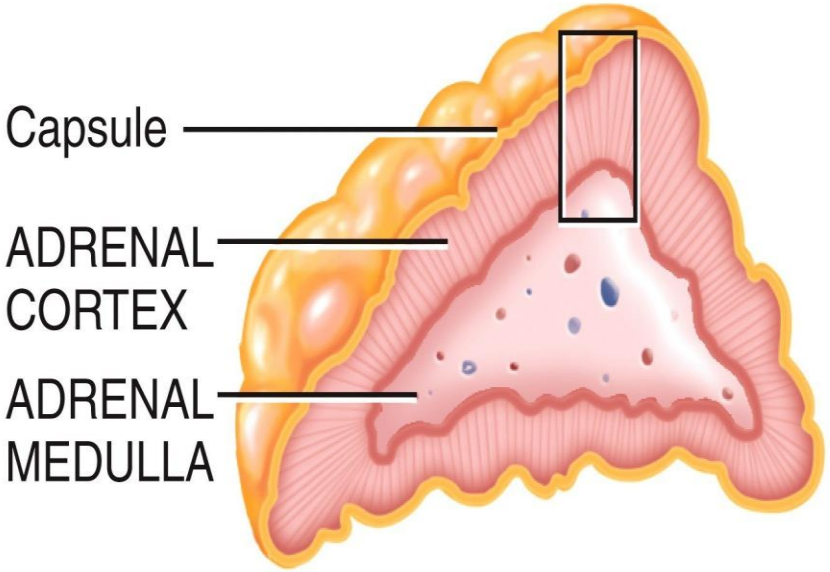
Adrenal Glands

- The **adrenal glands** (**suprarenal glands**) are located on top of each kidney.

- The glands are divided into two regions:
  - ✓ **the outer cortex** and the **medial medulla**.

القشرة الخارجية و النخاع الإنسي.

- The glands are covered by a connective tissue capsule.



(b) Section through left adrenal gland

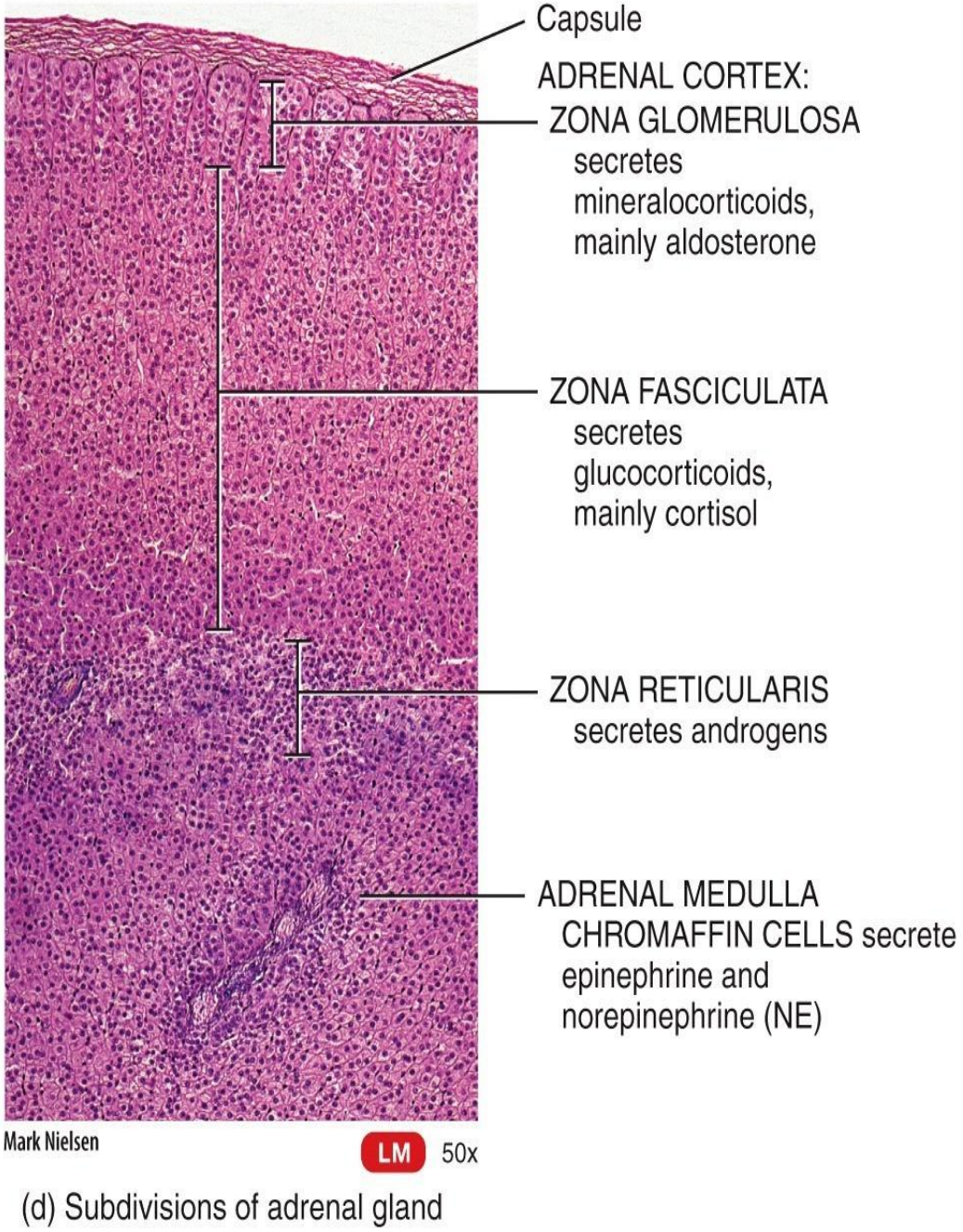
Adrenal Glands

The cortex is divided histologically into 3 regions:

القشرة مقسمة نسيجيا إلى 3 المناطق:

1. **The zona glomerulosa**
2. **The zona fasciculata**
3. **The zona reticularis**

1. المنطقة الكبيبات
2. المنطقة اللفافة
3. المنطقة الشبكية



(d) Subdivisions of adrenal gland

Adrenal Glands

تفرز المنطقة الكبيبية هرمونات تسمى

القشرية المعدنية المستخدمة لتنظيم المعادن

- The **zona glomerulosa** secretes hormones called **mineralocorticoids** used to regulate mineral homeostasis.

التوازن.

الألدوستيرون هو القشرية المعدنية الرئيسية التي يفرزها

بواسطة الغدة الكظرية. إنه يساعد على تنظيم الصوديوم و

- ✓ **Aldosterone** is the major mineralocorticoid secreted by the adrenal gland. It helps regulate sodium and potassium homeostasis.

توازن البوتاسيوم

- ✓ The **renin-angiotensin-aldosterone (RAA) pathway** controls secretion of aldosterone.

مسار الرينين-الأنجيوتنسين-الألدوستيرون (RAA)

يتحكم في إفراز الألدوستيرون.

Adrenal Glands

تفرز المنطقة اللفافية الهرمونات

تسمى جلايكورتيكودات تؤثر على الجلوكوز

زونا فاسيكولاتا

التوازن.

- The **zona fasciculata** secretes hormones called **glucocorticoids** that affect glucose homeostasis.

جلايكورتيكود

- The **zona reticularis** secretes weak **androgens** (hormones with masculinizing effects).

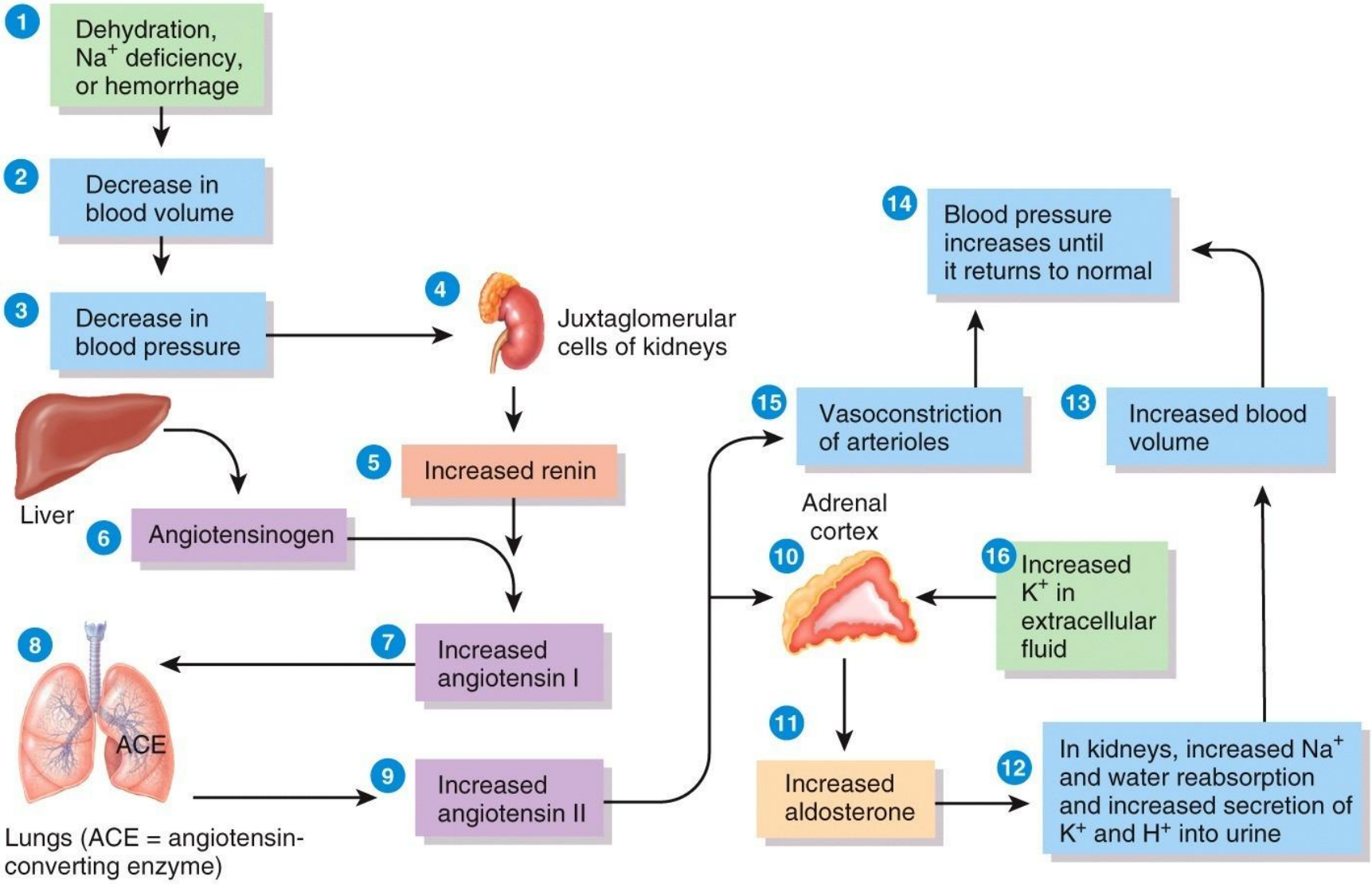
ذكوري

تفرز المنطقة الشبكية ضعيفة

الأندروجينات (الهرمونات مع الذكورة

التأثيرات).

Renin-Angiotensin-Aldosterone (RAA) pathway



Adrenal Glands

Secretion of **glucocorticoids** (cortisol [hydrocortisone]- the most produced, cortisone and corticosterone) is regulated by **negative feedback**.

إفراز الجلوكوكورتيكويد (الكورتيزول [هيدروكورتيزون]- الأكثر إنتاجا، الكورتيزون والكورتيكوستيرون) هو ينظمها ردود الفعل السلبية.

They help control:

- Protein breakdown
- Glucose formation
- Lipolysis
- Resistance to stress
- Inflammation
- Immune responses

إنهم يساعدون في التحكم في:

- انهيار البروتين
- تكوين الجلوكوز
- تحلل الدهون
- مقاومة الإجهاد
- التهاب
- الاستجابات المناعية

Adrenal Glands

- The major androgen secreted by the adrenal cortex is **dehydroepiandrosterone (DHEA)**. In **males**, after puberty the hormone **testosterone** is secreted in much larger quantities so DHEA has virtually no effect.

الأندروجين الرئيسي الذي تفرزه قشرة الغدة الكظرية
هو ديهيدروبياندروستيرون (DHEA). في الذكور،
بعد البلوغ، يفرز هرمون التستوستيرون
بكميات أكبر بكثير، لذا فإن DHEA ليس لديها تقريبا
تأثير.

- In **females**, DHEA and other adrenal androgens play a major role in **promoting libido** and are converted to **estrogens**. In menopausal women, all female estrogens come from adrenal androgens.

- في الإناث، DHEA وغيرها من الأندروجينات الكظرية
تلعب دورا رئيسيا في تعزيز الرغبة الجنسية وهي
تحول إلى هرمون الاستروجين. في النساء بعد انقطاع الطمث،
جميع هرمون الاستروجين الأنثوي يأتي من الغدة الكظرية
الأندروجينات

Adrenal Glands

يتم تحفيز النخاع الكظري بواسطة

الخلايا العصبية قبل العقدة المتعاطفة من

الجهاز العصبي اللاإرادي (ANS).

- The **adrenal medulla** is stimulated by sympathetic preganglionic neurons of the autonomic nervous system (ANS).

تفرز خلايا الكرومافين الإبينفرين

(الأدرينالين) والنورادرينالين

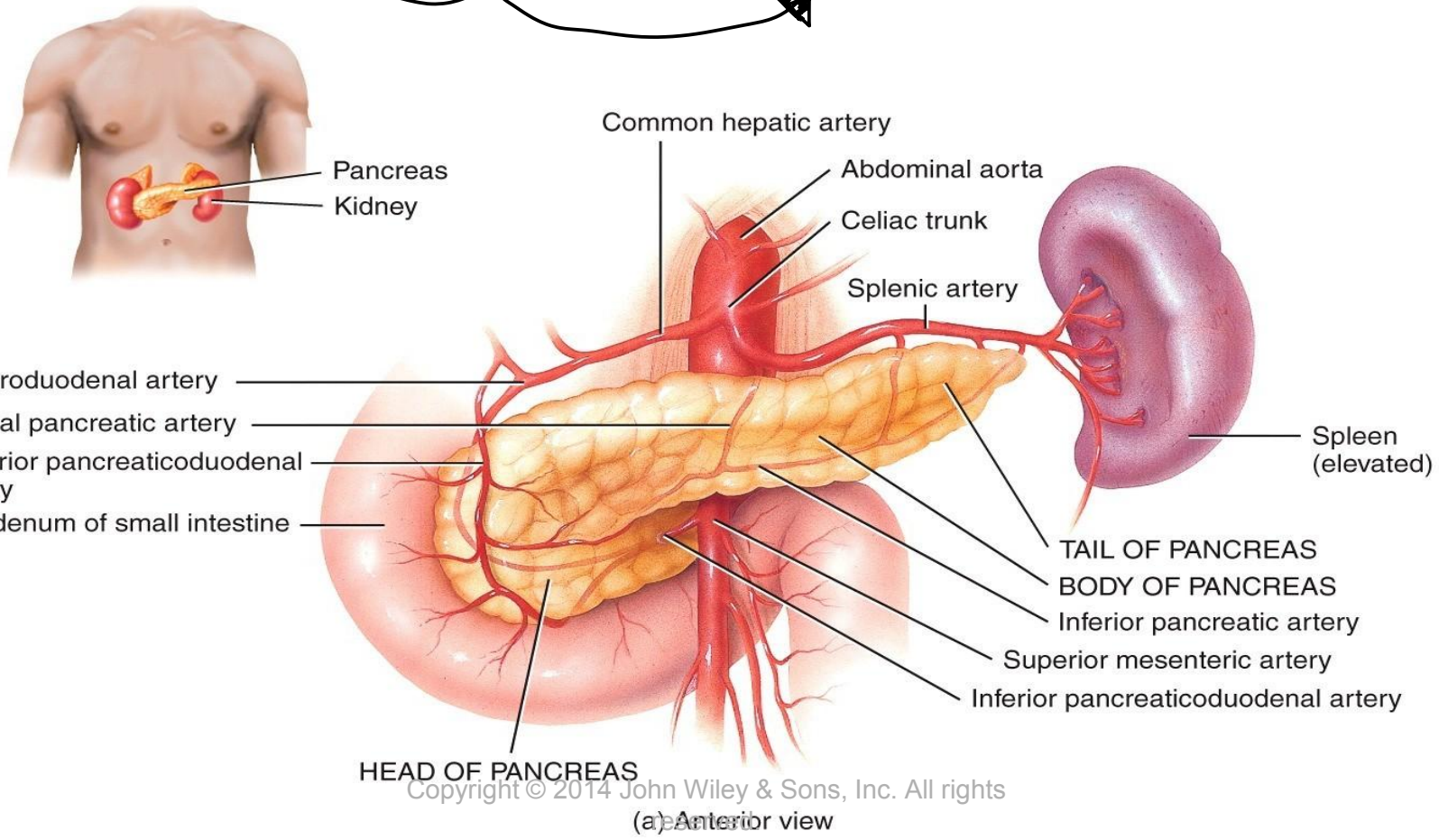
- **Chromaffin cells** secrete **epinephrine (adrenaline)** and **norepinephrine (noradrenaline)** both of which are involved in the **fight-or-flight response**.

(النورادرينالين) كلاهما في استجابة القتال أو الهروب.

Pancreatic Islets

البنكرياس هو كل من الغدد الصماء والغدد الخارجية. هو يقع في منحنى الاثني عشر.

The **pancreas** is both an endocrine and exocrine gland. It is located in the curve of the duodenum.



Pancreatic Islets

تقريبا جميع الخلايا الخارجية للإفرازات

يتم ترتيب البنكرياس في مجموعات تسمى الأسيني.

هذه تنتج إنزيمات هضمية

- Almost all of the exocrine cells of the pancreas are arranged in clusters called **acini**. These produce **digestive enzymes** that are delivered to the gastrointestinal tract through ducts.

يتم توصيله إلى الجهاز الهضمي من خلال القنوات.

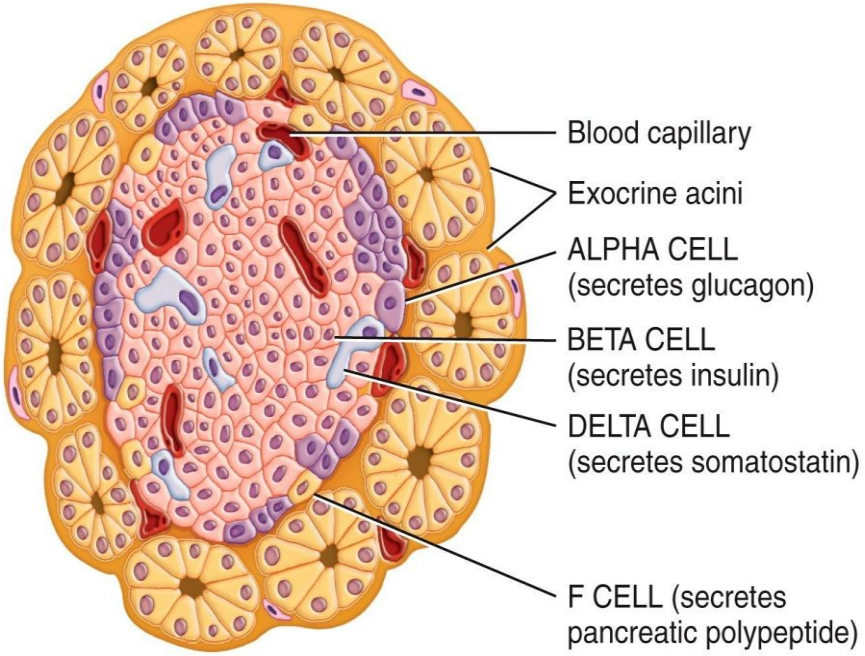
متناثرة بين الأسيني هي مجموعات من

أنسجة الغدد الصماء تسمى جزر البنكرياس

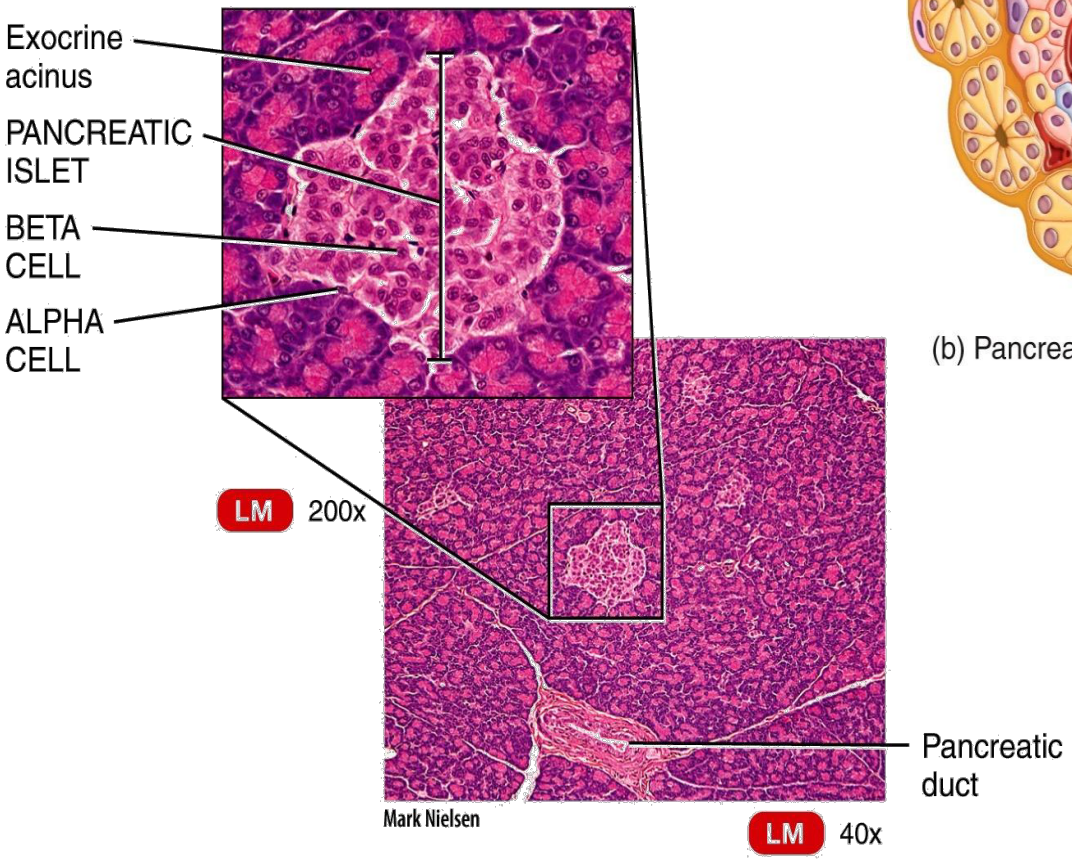
(جزر لانغرهانز)

- Scattered among the acini are clusters of endocrine tissue called **pancreatic islets (islets of Langerhans)**.

Pancreatic Islets



(b) Pancreatic islet and surrounding acini



(c) Pancreatic islet and surrounding acini

Pancreatic Islets

تحتوي الجزر الصغيرة على 4 أنواع من الخلايا التي تفرز

هرمونات مختلفة

The islets include 4 types of cells that secrete different hormones:

- **Alpha (A) cells** - glucagon
- **Beta (B) cells** - insulin
- **Delta (D) cells** - somatostatin
- **F cells** - pancreatic polypeptide

TABLE 18.9

Summary of Pancreatic Islet Hormones

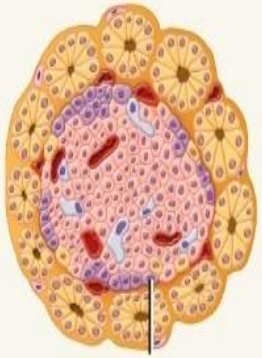
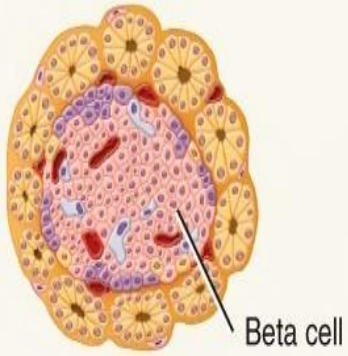
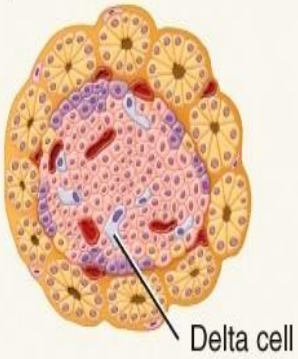
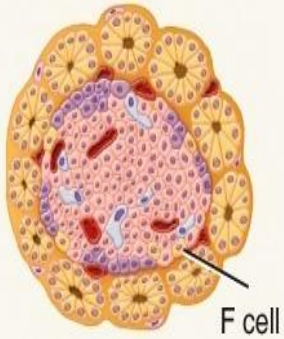
HORMONE AND SOURCE	CONTROL OF SECRETION	PRINCIPAL ACTIONS
Glucagon from alpha cells of pancreatic islets 	Decreased blood level of glucose, exercise, and mainly protein meals stimulate secretion; somatostatin and insulin inhibit secretion.	Raises blood glucose level by accelerating breakdown of glycogen into glucose in liver (glycogenolysis), converting other nutrients into glucose in liver (gluconeogenesis), and releasing glucose into blood.
Insulin from beta cells of pancreatic islets 	Increased blood level of glucose, acetylcholine (released by parasympathetic vagus nerve fibers), arginine and leucine (two amino acids), glucagon, GIP, hGH, and ACTH stimulate secretion; somatostatin inhibits secretion.	Lowers blood glucose level by accelerating transport of glucose into cells, converting glucose into glycogen (glycogenesis), and decreasing glycogenolysis and gluconeogenesis; increases lipogenesis and stimulates protein synthesis.

TABLE 18.9

Summary of Pancreatic Islet Hormones

HORMONE AND SOURCE	CONTROL OF SECRETION	PRINCIPAL ACTIONS
Somatostatin from delta cells of pancreatic islets 	Pancreatic polypeptide inhibits secretion.	Inhibits secretion of insulin and glucagon; slows absorption of nutrients from gastrointestinal tract.
Pancreatic polypeptide from F cells of pancreatic islets 	Meals containing protein, fasting, exercise, and acute hypoglycemia stimulate secretion; somatostatin and elevated blood glucose level inhibit secretion.	Inhibits somatostatin secretion, gallbladder contraction, and secretion of pancreatic digestive enzymes.

Ovaries and Testes

تنتج الغدد التناسلية (المبيض والخصيتين)

الأمشاج (البويضات والحيوانات المنوية على التوالي).

- **Gonads** (ovaries and testes) produce **gametes** (**oocytes** and **sperm** respectively).

- **Ovaries** produce two **estrogens** (**estradiol** and **estrone**), **progesterone**, **relaxin** and **inhibin**.

تنتج المبايض اثنين من هرمون الاستروجين (استراديول و

إيسترون)، البروجسترون، الاسترخاء والتثبيط

- **Testes** produce **testosterone**.

Ovaries & Testes

TABLE 18.10

Summary of Hormones of the Ovaries and Testes

HORMONE	PRINCIPAL ACTIONS
OVARIAN HORMONES	
Estrogens and progesterone	Together with gonadotropic hormones of anterior pituitary, regulate female reproductive cycle, maintain pregnancy, prepare mammary glands for lactation, and promote development and maintenance of female secondary sex characteristics.
 Ovary	
Relaxin (RLX)	Increases flexibility of pubic symphysis during pregnancy; helps dilate uterine cervix during labor and delivery.
Inhibin	Inhibits secretion of FSH from anterior pituitary.
TESTICULAR HORMONES	
Testosterone	Stimulates descent of testes before birth; regulates sperm production; promotes development and maintenance of male secondary sex characteristics.
	
Inhibin	Inhibits secretion of FSH from anterior pituitary.

Pineal Gland and Thymus

ترتبط الغدة الصنوبرية بسقف الثالث البطين في الدماغ ويفرز الميلاتونين الذي يساعد على تنظيم الساعة البيولوجية للجسم.

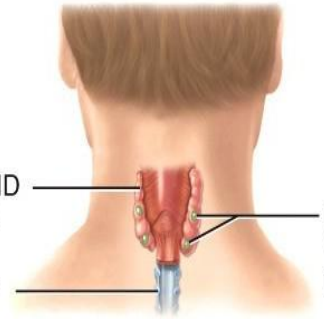
- The **pineal gland** is attached to the roof of the third ventricle of the brain and secretes **melatonin** which helps to regulate the body's biological clock.

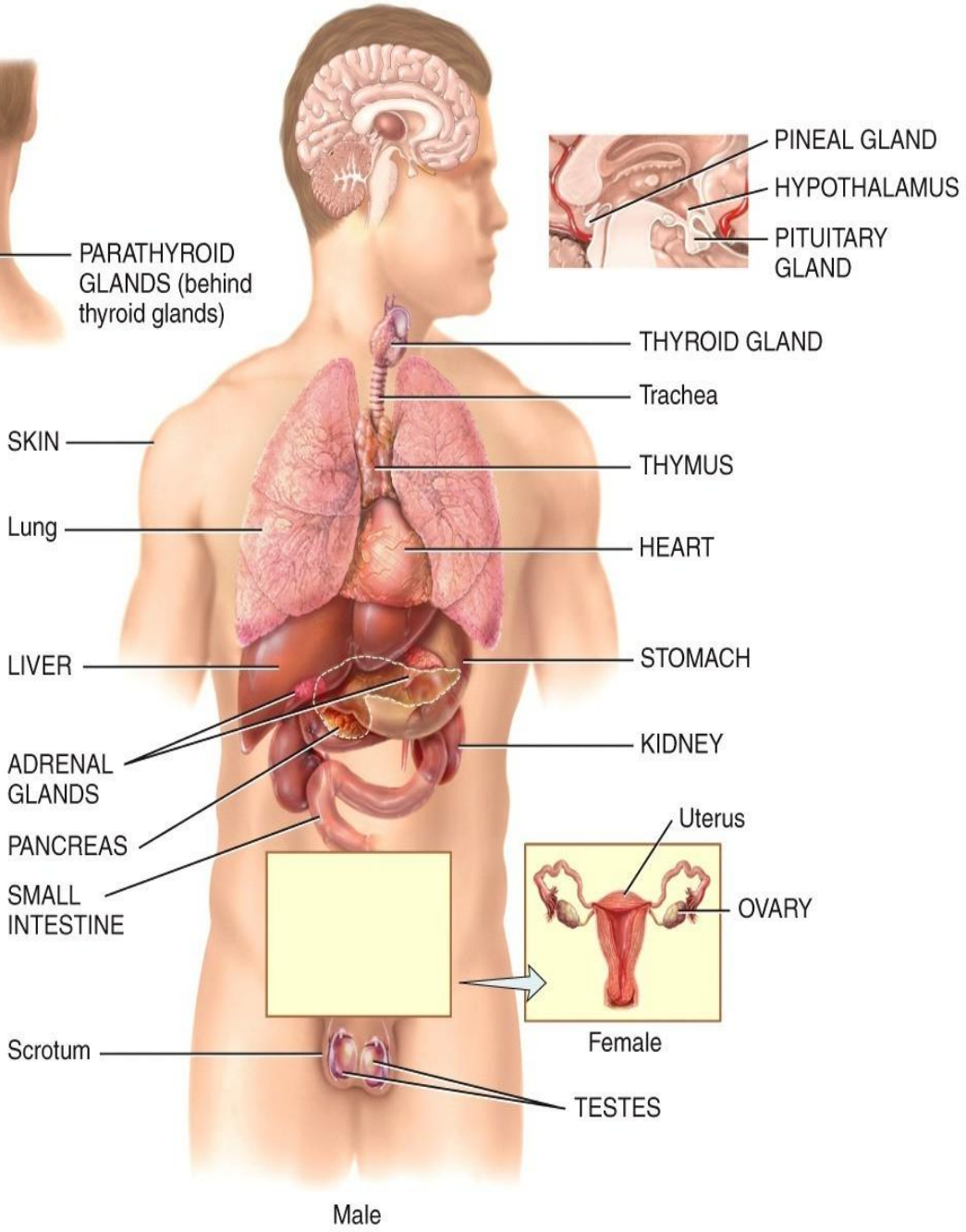
- The **thymus** is located behind the sternum between the lungs. It produces **thymosin**, **thymic humoral factor (THF)**, **thymic factor (TF)** and **thymopoietin**, all of which promote maturation of the immune system's **T cells**.

تقع الغدة الصعترية خلف القص بين الرئتين. ينتج الثيموسين، الغدة الصعترية الخلطية العامل (THF)، عامل الغدة الصعترية (TF) و الثيموبويتين، وكلها تعزز نضوج الخلايا التائية للجهاز المناعي

Sara Aizatari

Pineal Gland & Thymus





HUMAN ANATOMY & PHYSIOLOGY

Anatomy of Heart

Hamza Abu Hilail
M.Sc. Physiology

Anatomy of the Heart

- Relatively small, conical organ approximately the size of a person's clenched fist.

✓it weighs about 250 to 350 grams

- Located left of the body midline **posterior** to the sternum in the lower middle mediastinum.

عضلة القص

- The posterosuperior surface of the heart, formed primarily by the **left atrium**, is called the **base**.

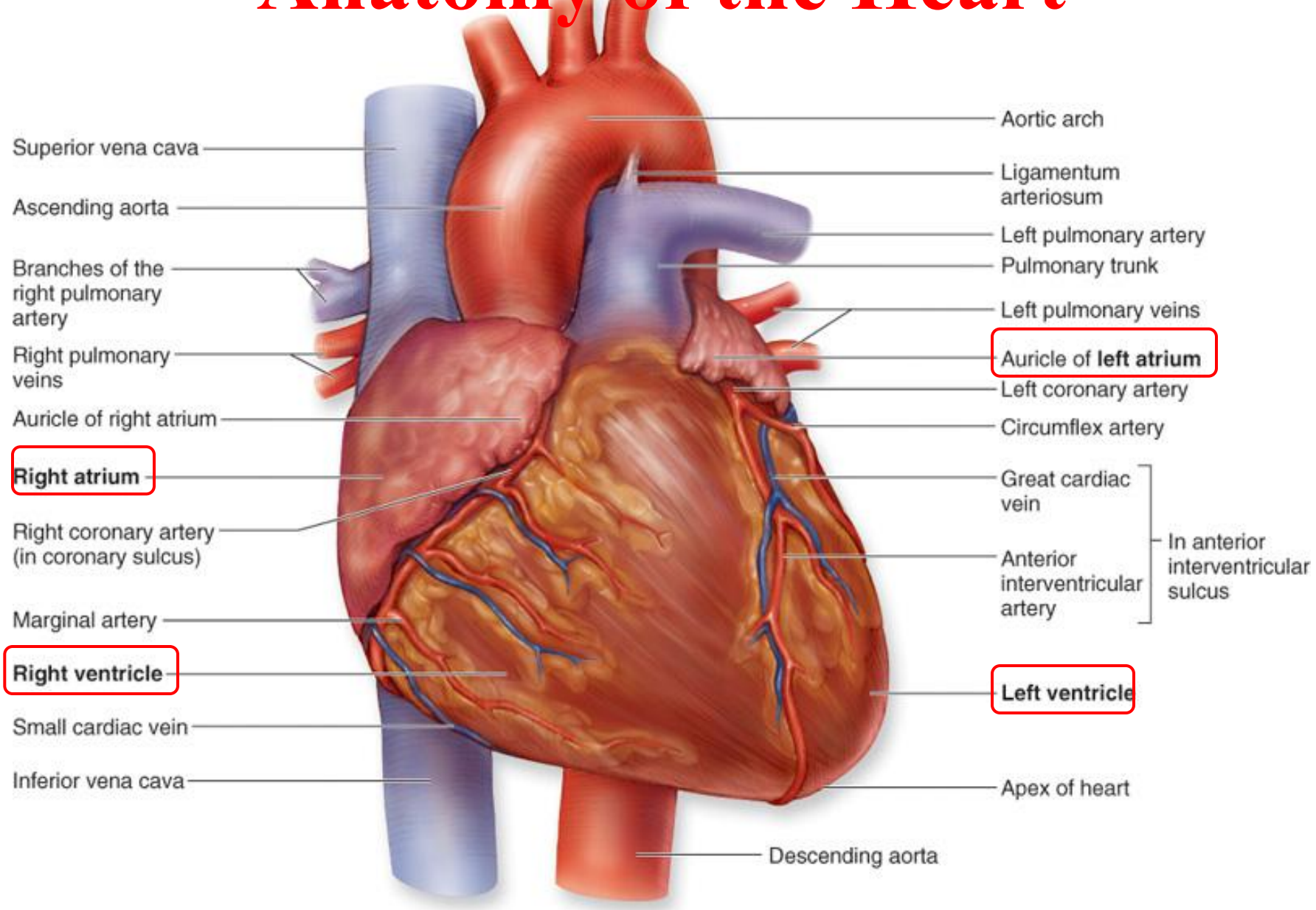
أذين

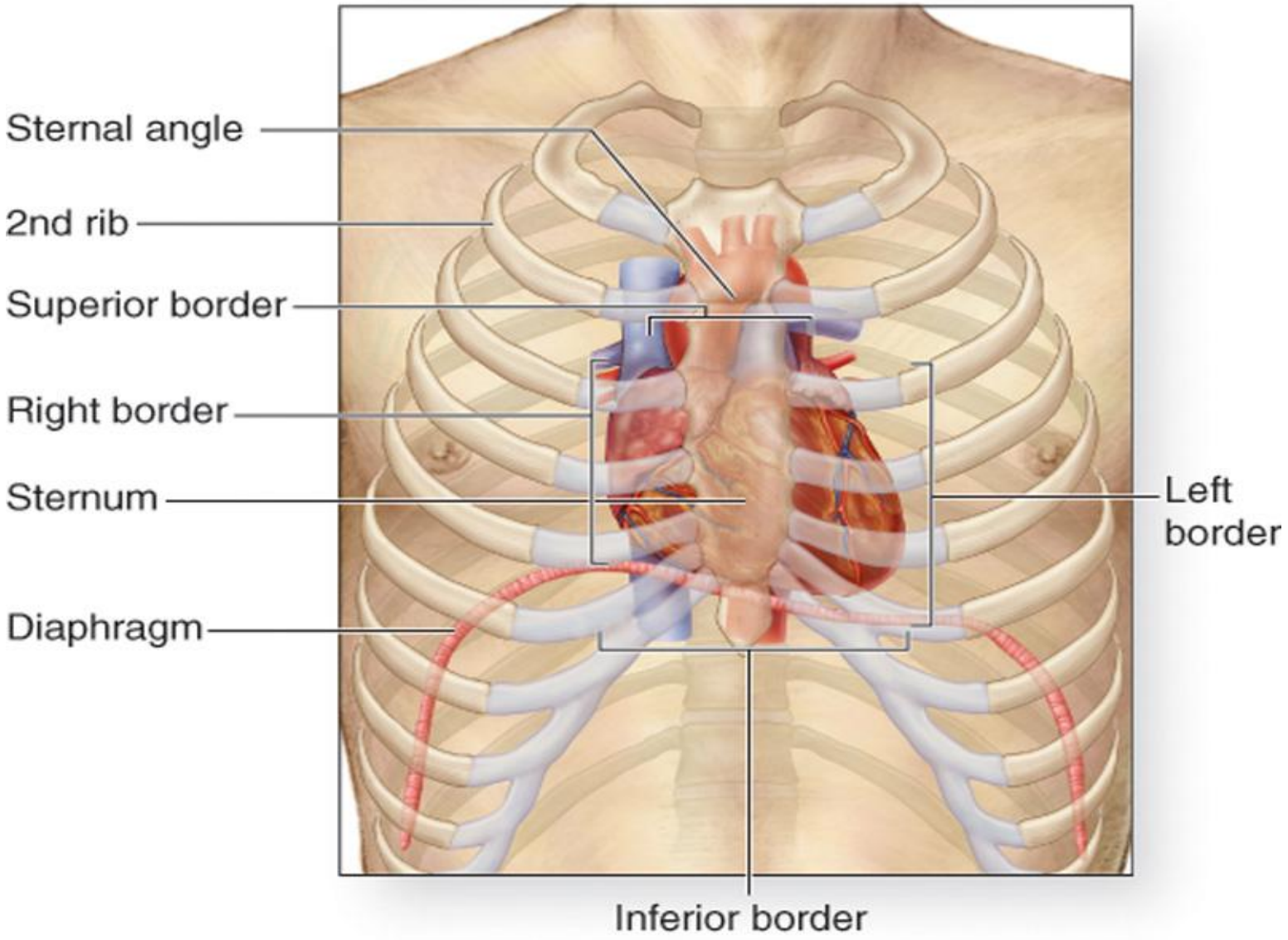
السطح الخلفي العلوي للقلب، الذي يتكون في المقام الأول من الأذين الأيسر، يسمى القاعدة

يطلق على الطرف المخروطي السفلي اسم القمة

- The inferior, conical end is called the **apex**

Anatomy of the Heart





(a) Anterior view

Functions of the Heart

1. Connects to blood vessels that transport blood between the heart and other body tissues.

2. Arteries carry blood high in oxygen.
   - (except for the pulmonary arteries)

2. تحمل الشرايين الدم بنسبة عالية من الأكسجين.
   - (باستثناء الشرايين الرئوية)

3. Veins carry blood low in oxygen.
   - (except for the pulmonary veins)

4. Arteries and veins entering and leaving the heart are called great vessels.

Heart Wall Structure

- Heart wall consists of three distinctive layers:
  1. **external epicardium**
  2. **middle myocardium**
  3. **internal endocardium**

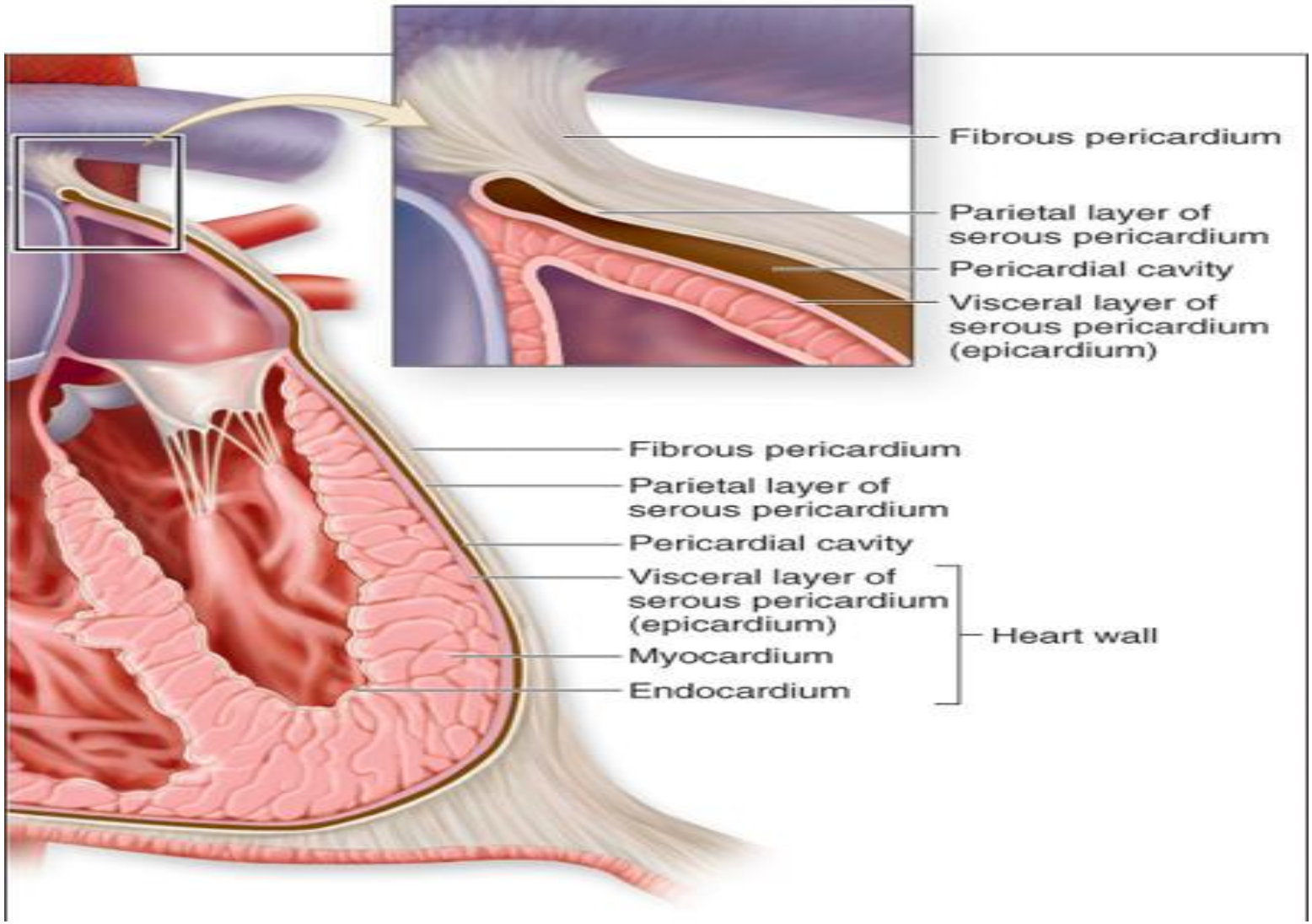
فوق القلب

- **Epicardium** is the outermost heart layer and is also known as the **visceral layer of serous pericardium**.

الطبقة الحشوية من التامور المصلي

- As we age, more fat is deposited in the epicardium, and so this layer becomes thicker and more fatty.

Pericardial Layers of the Heart



Heart Wall Structure

عضلة القلب هي الطبقة الوسطى من جدار القلب و

عضلة القلب

يتكون بشكل أساسي من أنسجة عضلة القلب

- **Myocardium** is the middle layer of the heart wall and is composed chiefly of **cardiac muscle tissue.**

أنسجة عضلة القلب

عضلة القلب هي الأكثر سمكا من جدران القلب الثلاثة

- Myocardium is the thickest of the three heart wall layers.

طبقات.

- تقع في عمق فوق القلب وسطحية إلى
  - It lies deep to the epicardium and superficial to the endocardium

الشغاف

- السطح الداخلي للقلب والأسطح الخارجية ل

صمامات القلب مغطاة ببطانة رقيقة

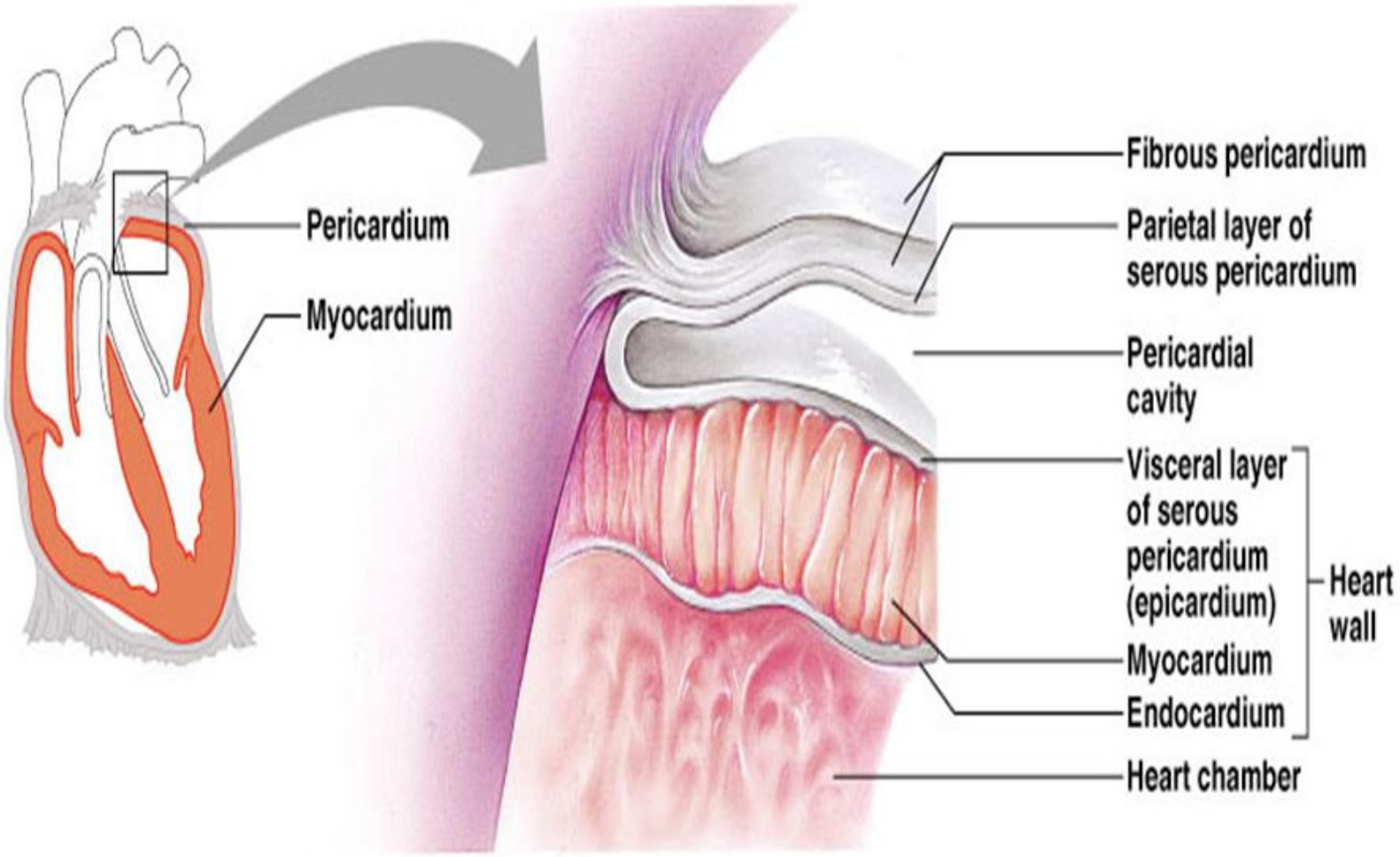
- Internal surface of the heart and the external surfaces of the heart valves are covered by a **thin endothelium** called the **endocardium**.

يسمى الشغاف

رقيقة

طبقات التامور للقلب

Pericardial Layers of the Heart



External Anatomy of the Heart

- Composed of four hollow chambers: two smaller **atria** and two larger **ventricles**.
- **Atria** are thin-walled chambers that are located superiorly.
- **anterior part** of each atrium is a wrinkled, flaplike extension called an **auricle**

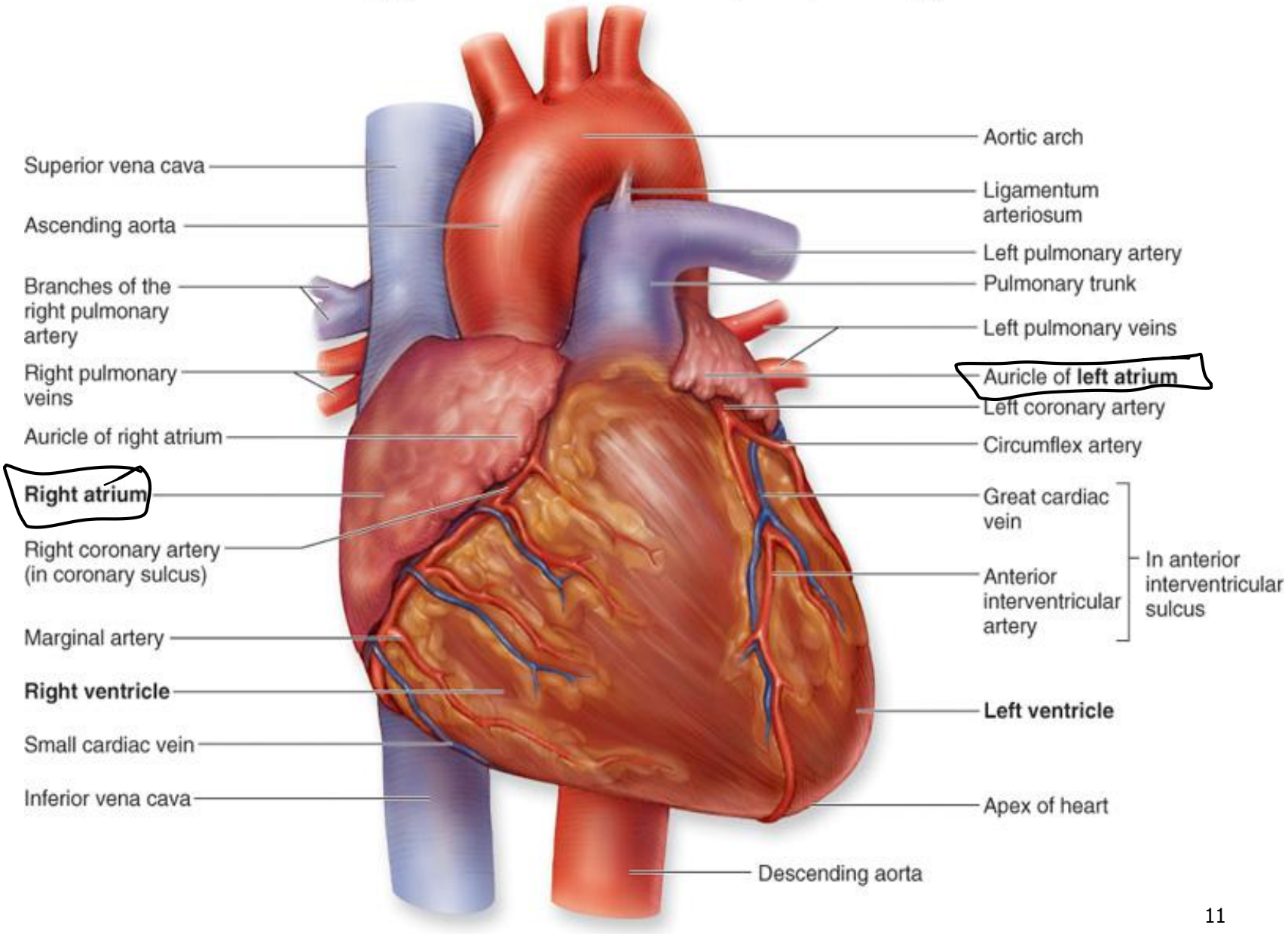
الجزء الأمامي من كل أذين مجعد يشبه الرفرفة تمديد يسمى الأذن

- **Atria** receive blood returning to
  - Right atrium receives blood from the **systemic circuit**
  - left atrium receives blood from the **pulmonary circuit**

تتلقى الأذينين الدم العائد إلى

- يتلقى الأذين الأيمن الدم من الدائرة الجهازية
- يستقبل الأذين الأيسر الدم من الدائرة الرئوية

الدائرة الرئوية



External Anatomy of the Heart

- Blood that enters an atrium is passed to the **ventricle** on the same side of the heart.

يتم تمرير الدم الذي يدخل الأذين إلى البطين على نفس الجانب من القلب.

- **Ventricles** are the inferior chambers.

- **The pulmonary trunk** carries blood from the right ventricle **into the pulmonary circuit**.

يقوم الشريان الأورطي بتوصيل الدم من البطين الأيسر في الدائرة الجهازية.

- **The aorta** conducts blood from the left ventricle into the **systemic circuit**.

Pulmonary Circuit

&

Systemic Circuit

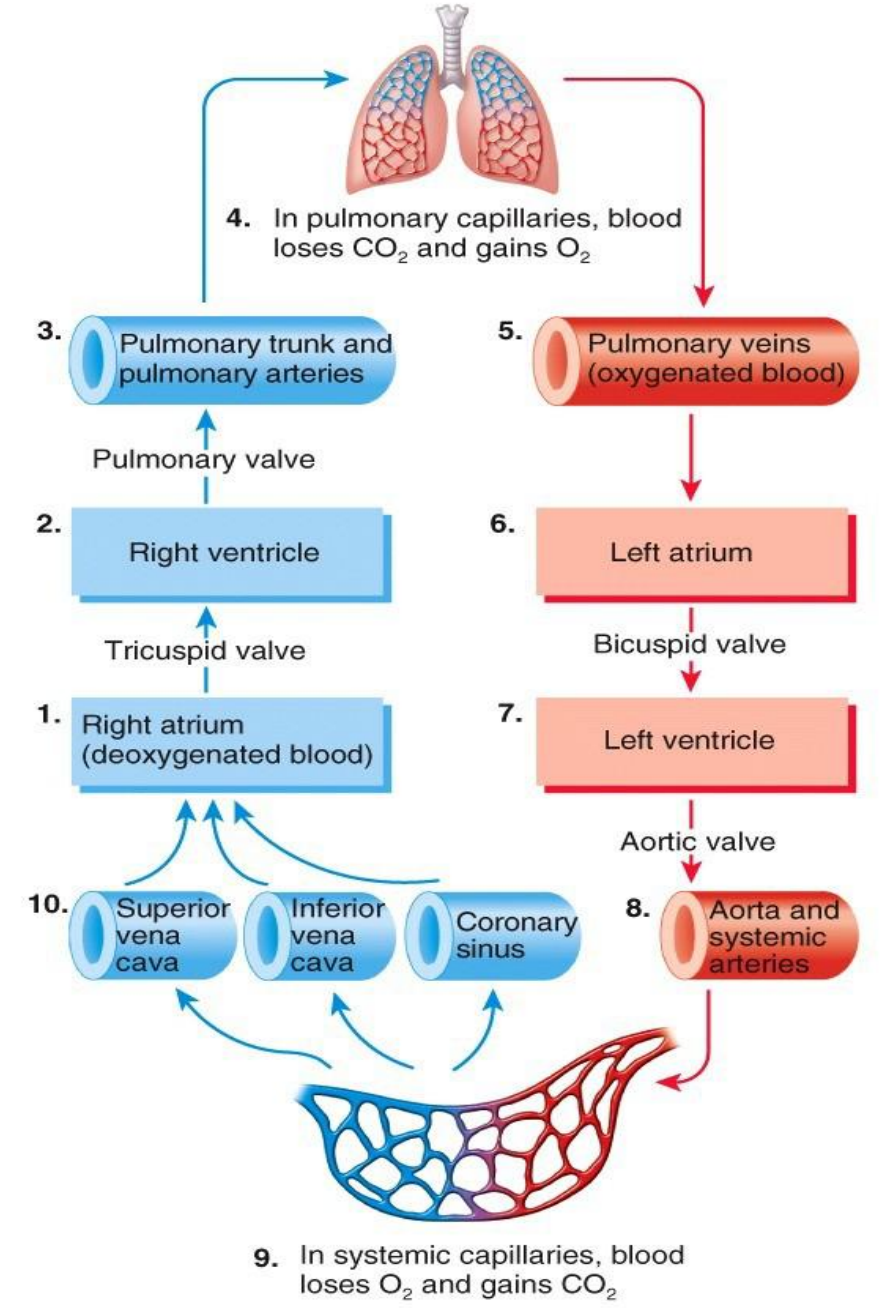
Systemic Circuits

- **Systemic circuit** allows oxygenated blood from the left heart to be delivered to tissue cells through arteries and arterioles, and deoxygenated blood is transported back to the right heart through veins and venues.
- Oxygenated blood in LV → aorta → arteries → arterioles → capillaries in tissues (gas exchange occurs) → deoxygenated blood travels in venules → veins → superior & inferior vena cava → RA.

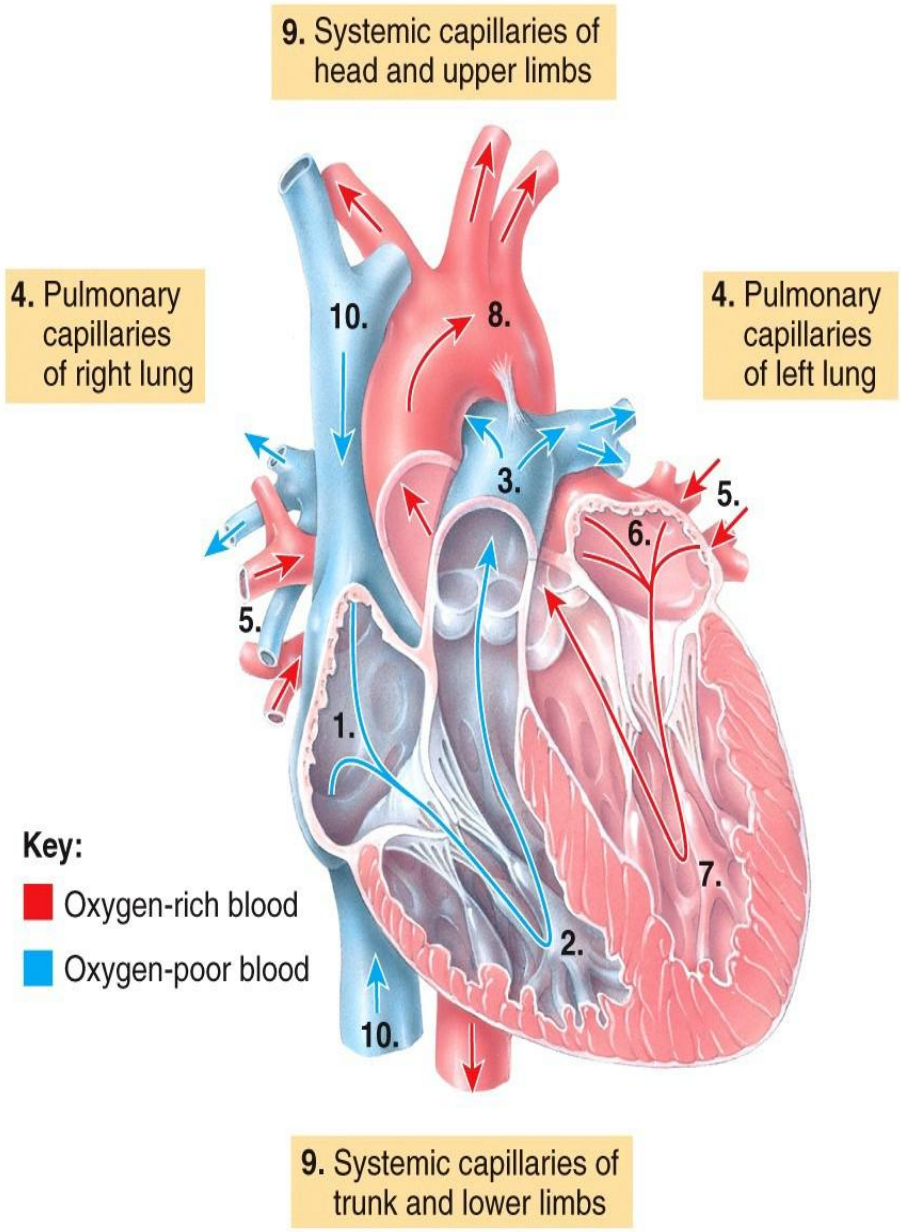
Pulmonary Circuits

- **Pulmonary circuit** allows deoxygenated blood to be transported into the lungs for gas exchange so that oxygenated blood can once again flow into the left heart

- Deoxygenated blood from body tissues →superior & inferior vena cava →RA →RV →pulmonary arteries →lungs (gas exchange occurs) →oxygenated blood travels in pulmonary veins →LA →bicuspid valve →LV.



(b) Path of blood flow through systemic and pulmonary circulations



(a) Path of blood flow through heart

Internal Anatomy of the Heart

- There are four heart chambers:
  1. **right atrium**
  2. **right ventricle**
  3. **left atrium**
  4. **left ventricle**

- Each plays a role in the continuous process of blood circulation.

- **Valves** permit the passage of blood in one direction and prevent its backflow.

الأذين الأيمن

Right Atrium

يتلقى الدم الوريدي من الدائرة الجهازية و عضلة القلب نفسها.

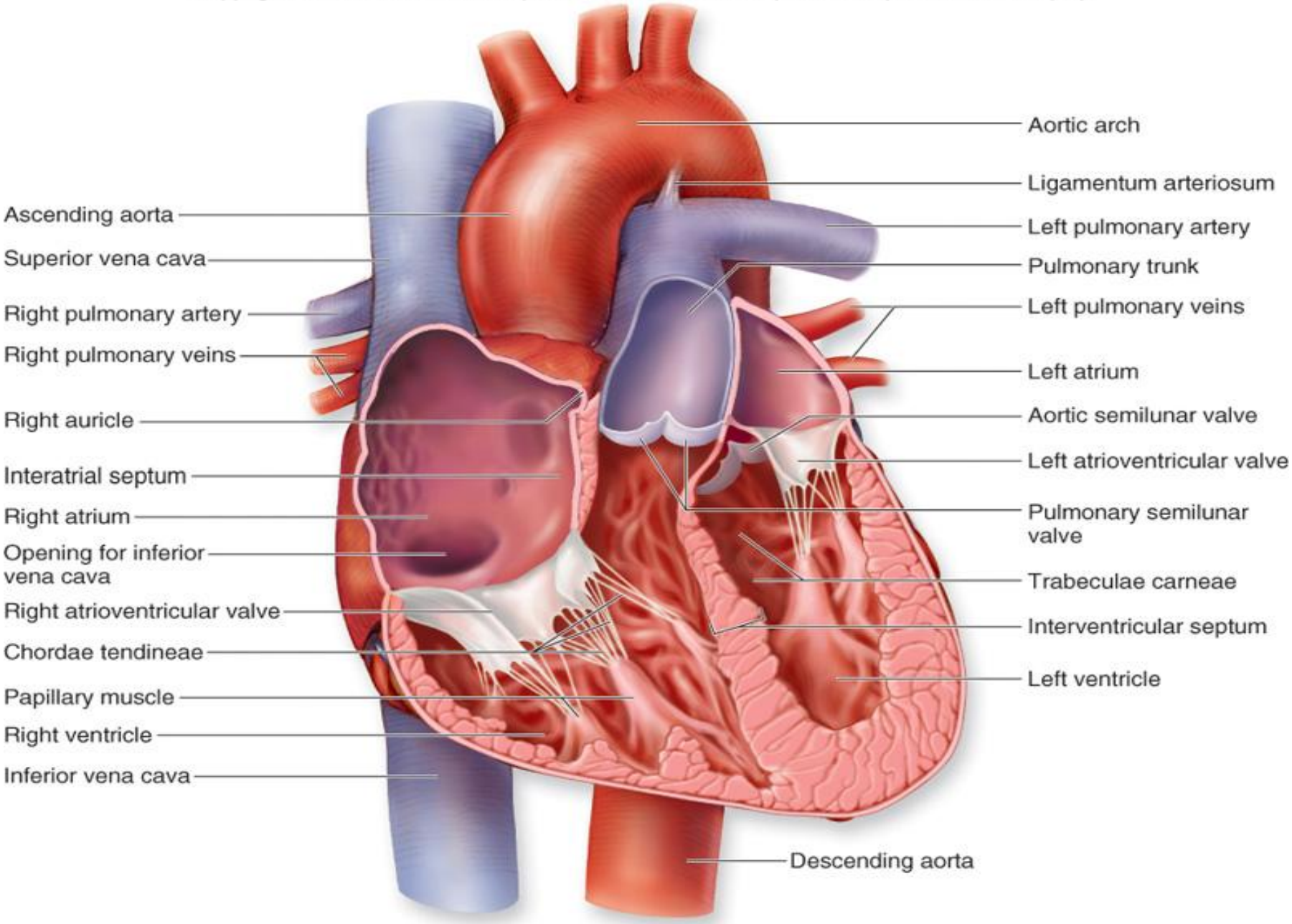
- Receives venous blood from the systemic circuit and the heart muscle itself.

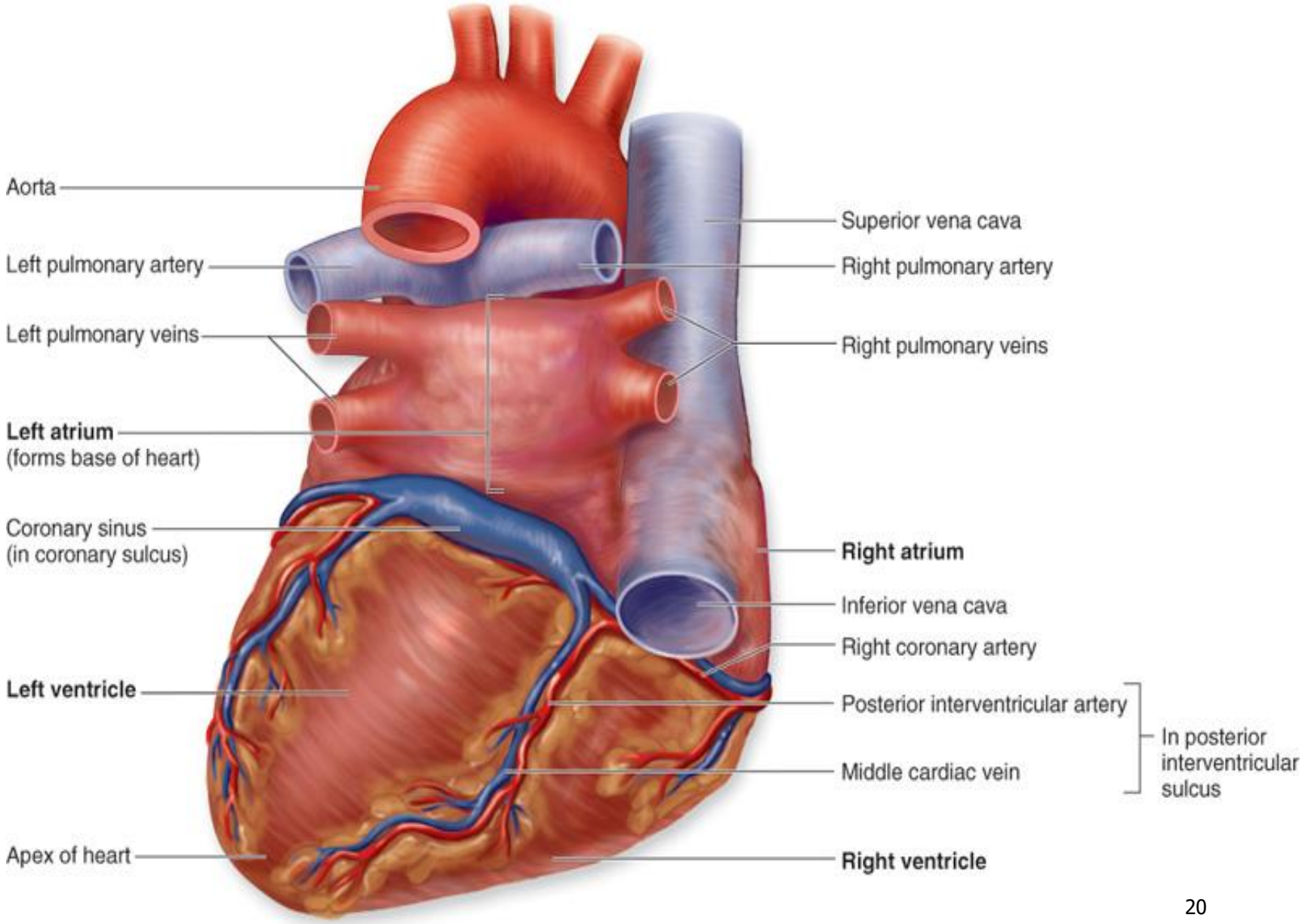
- **Three major vessels empty into the right atrium.**

1. **superior vena cava** drains blood from the head, upper limbs, and superior regions of the trunk
2. **inferior vena cava** drains blood from the lower limbs and trunk
3. **coronary sinus** drains blood from the heart wall

يشكل الحاجز بين الأذينين جدارا بين اليمين و الأذين الأيسر

- The **interatrial septum** forms a wall between the right and left atria.





الصمام الأذيني البطيني الأيمن (AV)

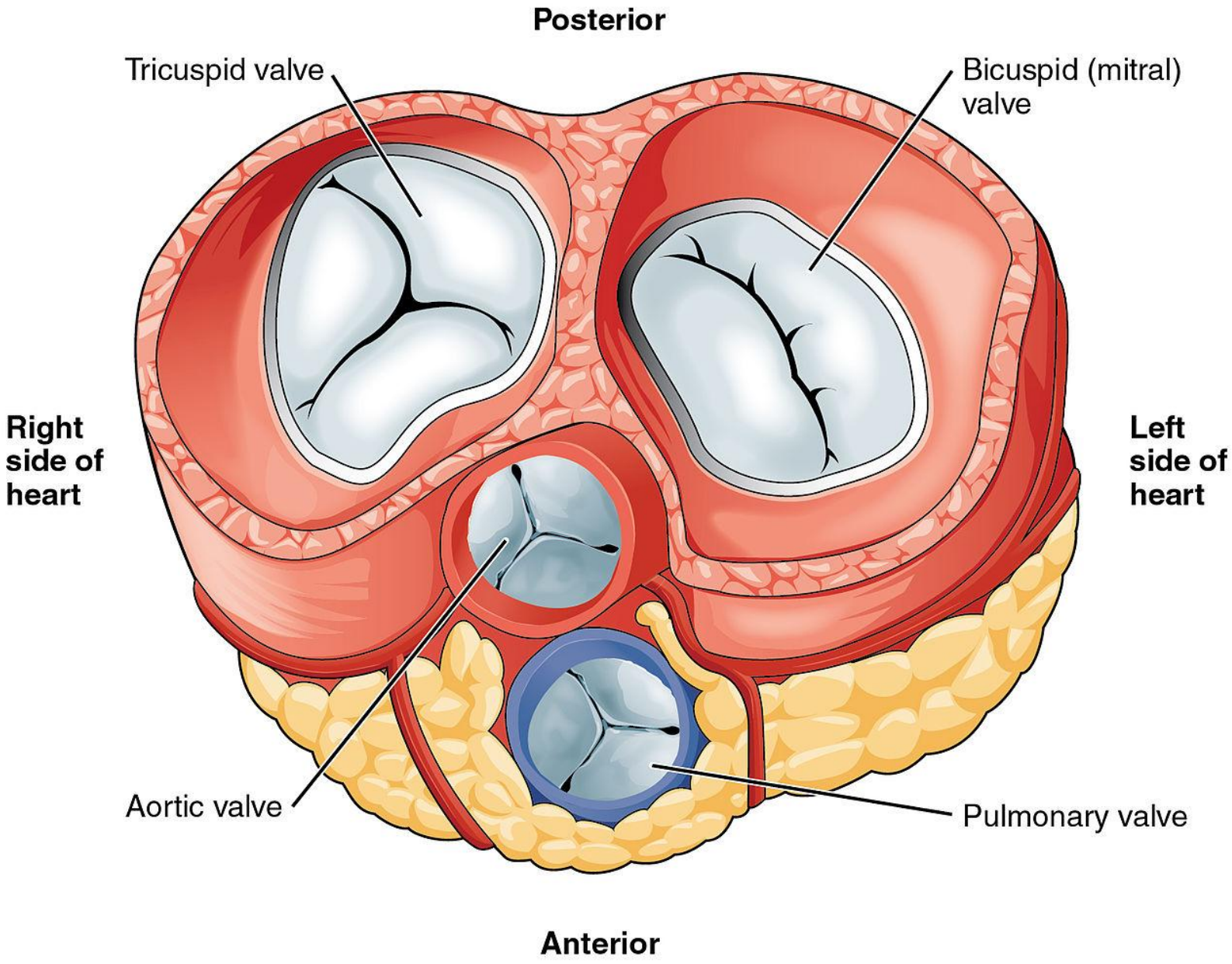
Right Atrioventricular (AV) Valve

- Separates the right atrium from the right ventricle. Also called the **tricuspid valve**.
- Venous blood flows from the **right atrium**, through the valve into the **right ventricle**.

يتدفق الدم الوريدي من الأذين الأيمن، من خلال الصمام في البطين الأيمن

- It's forced closed when the right ventricle begins to contract, preventing blood **backflow** into the right atrium.

يتم إجباره على الإغلاق عندما يبدأ البطين الأيمن في العقد، يمنع ارتجاع الدم إلى اليمين الأذين


Posterior
Tricuspid valve
Bicuspid (mitral) valve
Right side of heart
Left side of heart
Aortic valve
Pulmonary valve
Anterior

Right Ventricle

البطين الأيمن

- Receives deoxygenated venous blood from the right atrium.

يتلقى الدم الوريدي منزوع الأكسجين من اليمين الأذين.

يشكل الحاجز بين البطينين جدارا بين البطينين الأيمن والأيسر

- **Interventricular septum** forms a wall between the right and left ventricles.

يحتوي سطح الجدار الداخلي لكل بطين على ثلاثة إسقاطات عضلية على شكل مخروط تسمى حليمي العضلات، التي:

- The internal wall surface of each ventricle has three cone-shaped, muscular projections called **papillary muscles**, which:
  - Anchor **chordae tendineae**
  - Attach to the cusp of the right AV valve

مرساة وترية وترية

❖تعلق على ذروة الصمام AV الأيمن

الجذع الرئوي

Pulmonary Trunk

الصمام نصف القمري الرئوي

- The **pulmonary semilunar valve** marks the end of the right ventricle and the entrance into the pulmonary trunk.

البطين الأيمن

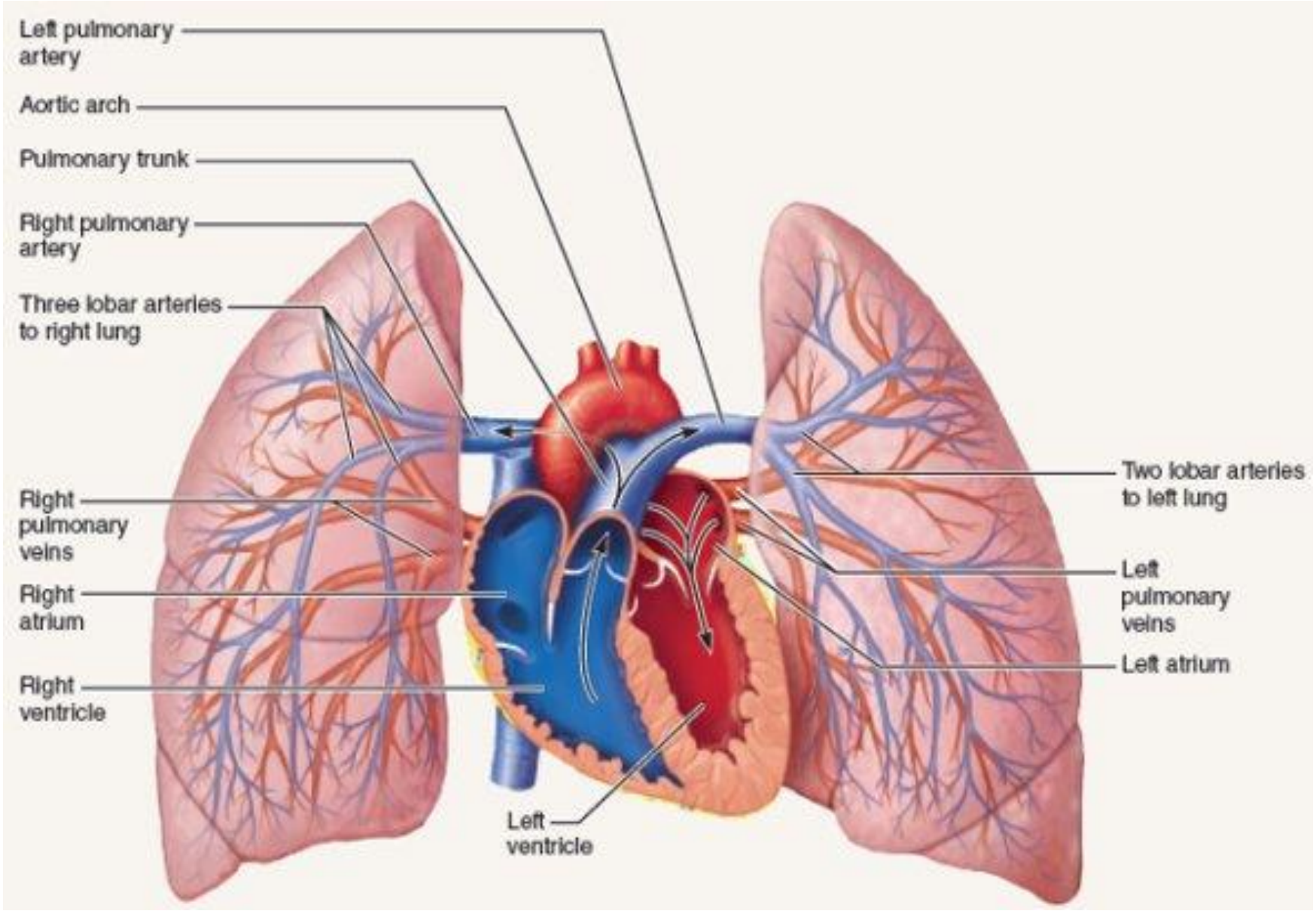
الجذع الرئوي ينقسم سريعًا إلى الشريان الرئوي الأيمن والشريان الرئوي الأيسر.

- **Pulmonary trunk** divides shortly into right and left pulmonary arteries.

- Pulmonary trunk carry **deoxygenated blood** to the lungs

يحمل الجذع الرئوي الدم منزوع الأكسجين إلى

الرئتين


Left pulmonary artery
Aortic arch
Pulmonary trunk
Right pulmonary artery
Three lobar arteries to right lung
Right pulmonary veins
Right atrium
Right ventricle
Left ventricle
Two lobar arteries to left lung
Left pulmonary veins
Left atrium

الأذين الأيسر

Left Atrium

بمجرد حدوث تبادل الغاز في الرئتين،

ينتقل الدم المؤكسج عبر الرئة

الأوردة إلى الأذين الأيسر

- Once gas exchange occurs in the lungs, the oxygenated blood travels through the pulmonary **veins to the left atrium**.

يحتوي الجدار الخلفي الأملس للأذين الأيسر على

فتحات لحوالي أربعة رئوية

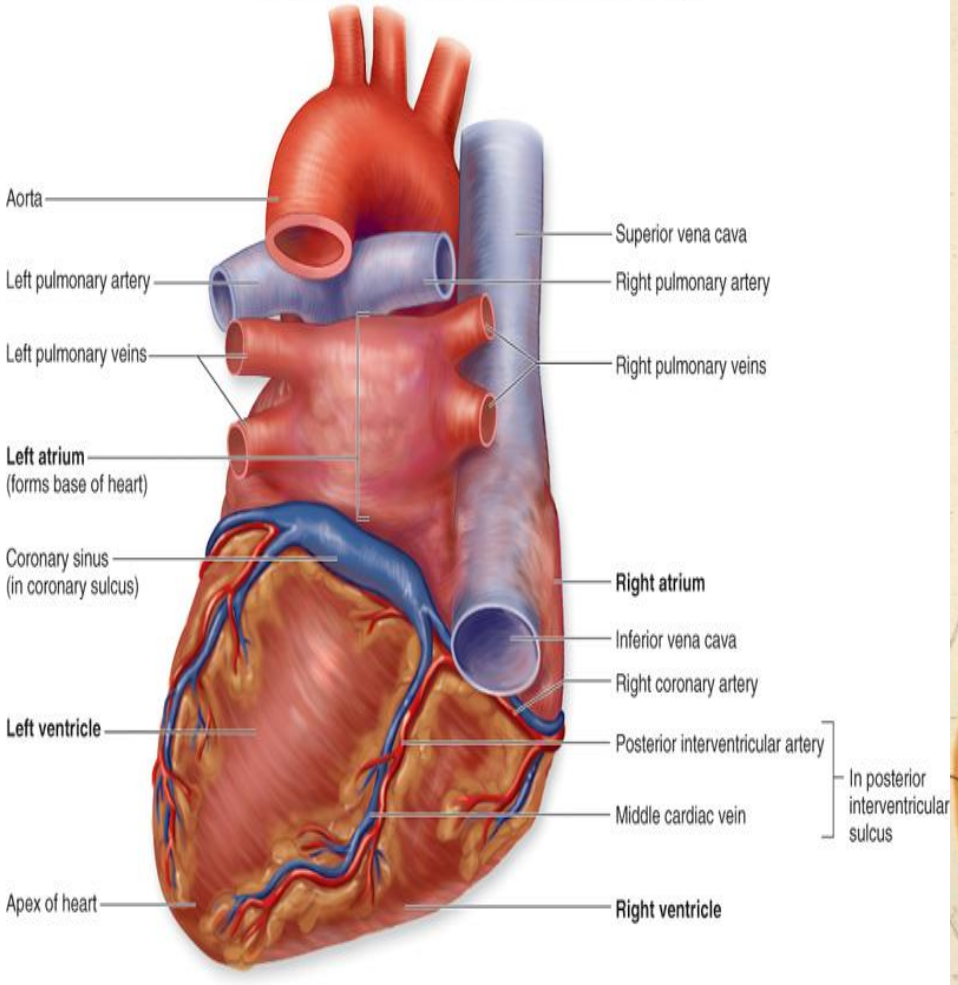
الأوردة.

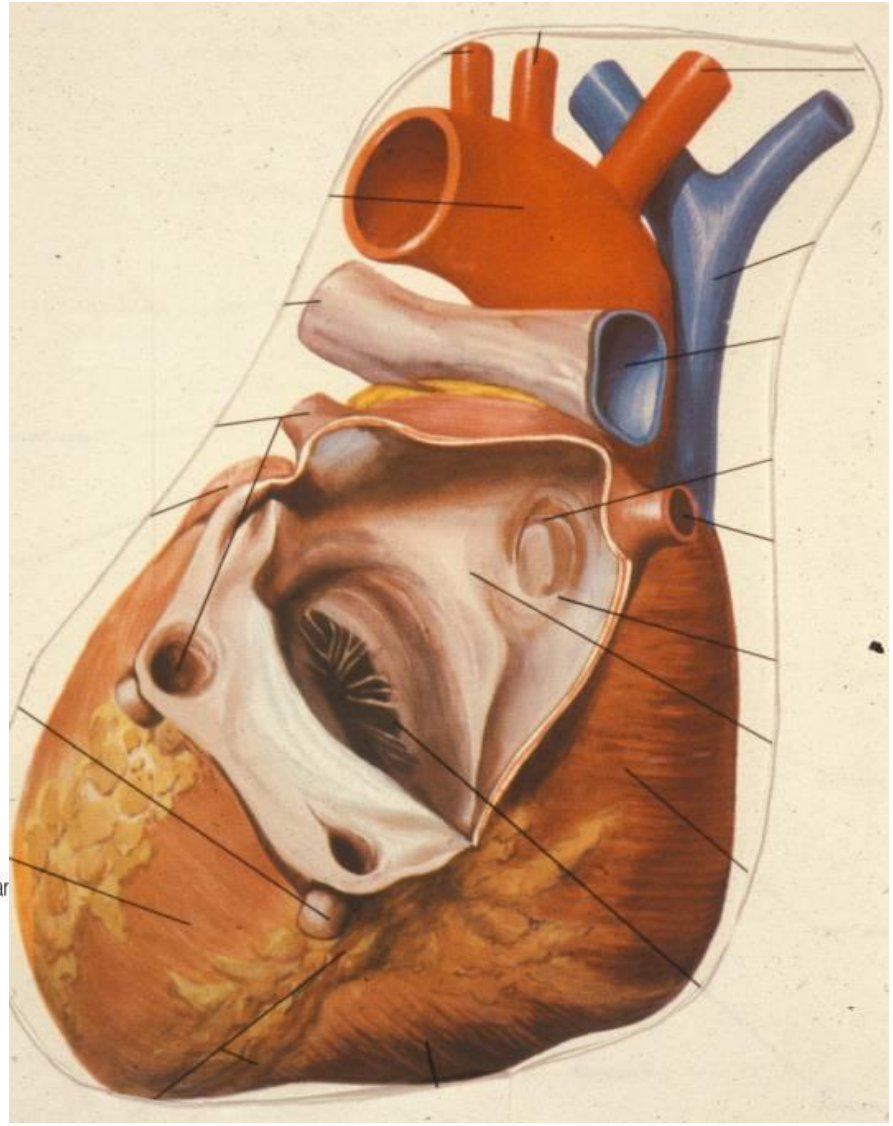
- Smooth posterior wall of the left atrium contains openings for approximately **four pulmonary veins**.

- Has pectinate muscles along its anterior wall as well as an auricle.

لديه عضلات البكتين على طول جداره الأمامي مثل

كذلك كأذن.





البطين الأيسر

Left Ventricle

ترتبط عضلتان حليميتان كبيرتان ب

الأوتار الأوتار التي تساعد في دعم اليسار

صمام AV

- Two large papillary muscles attach to the **chordae tendineae** that help support the left AV valve.

في الطرف العلوي من تجويف البطين،

الصمام الأذيني البطيني الأيمن (AV)

يمثل الصمام نصف القمري الأبهري نهاية

البطين الأيسر والمدخل إلى الشريان الأورطي.

- At the superior end of the ventricular cavity, the **aortic semilunar valve** marks the end of the left ventricle and the entrance into the aorta.

البطين الأيسر

Left Ventricle

- **Largest** of the four heart chambers.

عادة ما يكون الجدار أكثر سمكا بثلاث مرات من اليمين

جدار البطين

- Wall is typically three times thicker than the right ventricular wall.

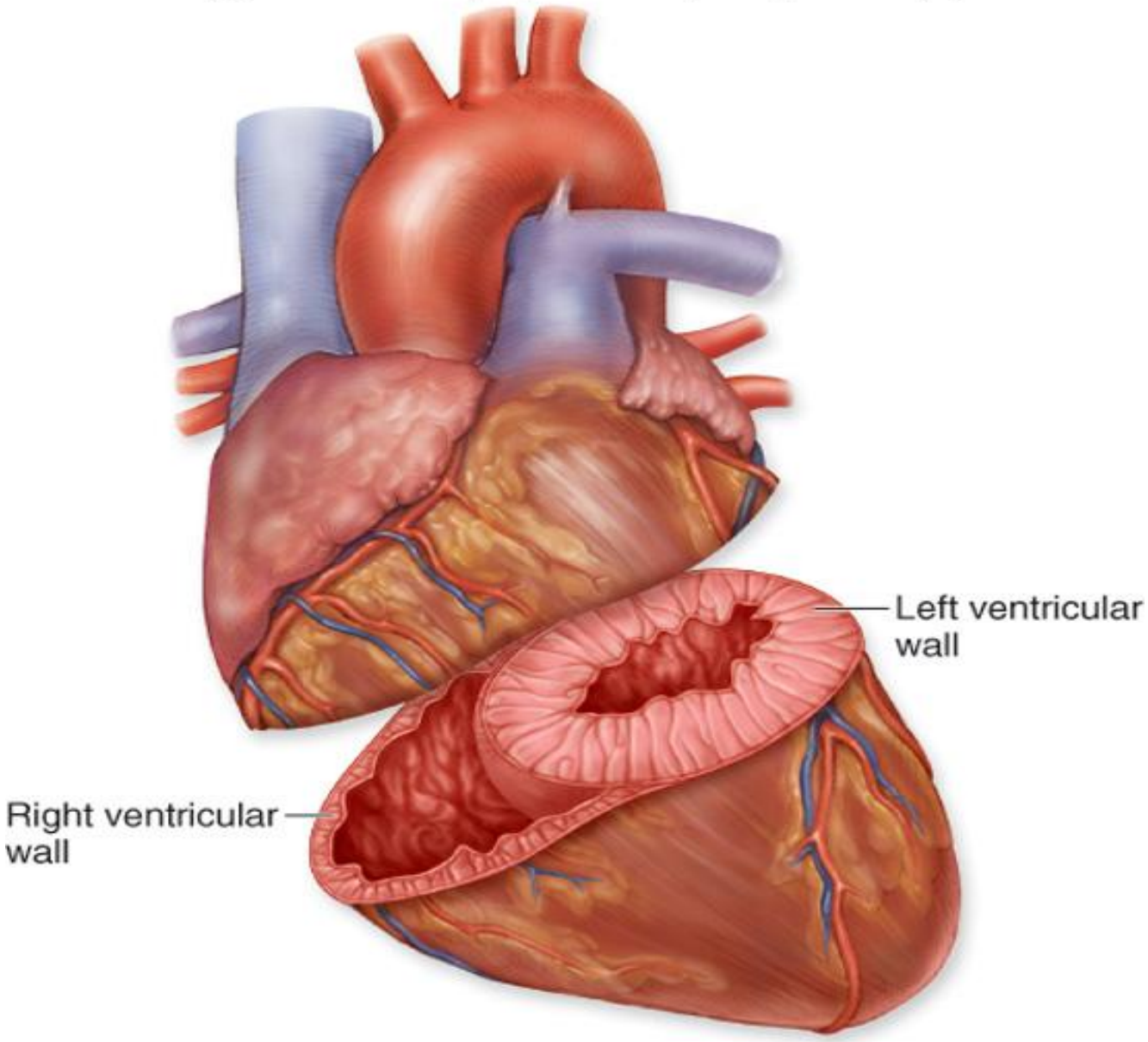
يتطلب جدران سميكة من أجل توليد ما يكفي

الضغط لإجبار الدم المؤكسج على الدخول إلى

الشريان الأورطي ثم من خلال الجهاز بأكمله

- Requires thick walls in order to generate enough pressure to force the oxygenated blood **into the aorta** and then through the **entire systemic circuit.**

دائرة



الصمام الأذيني البطيني الأيسر (AV)

Left Atrioventricular (AV) Valve

- Separates the **left atrium** from the **left ventricle**.
- ❖ Also called the **bicuspid valve** or the **mitral valve**.

الصمام الثنائي الشرف أو الصمام التاجي.

يحتوي الصمام AV الأيسر على وتر وتري مشابه لتلك

من الصمام AV الأيمن.

- Left AV valve **has chordae tendineae** similar to those of the right AV valve.
- Oxygenated blood flows from the left atrium into the left ventricle.
- Is forced closed when the left ventricle begins to contract

الصمامات نصف القمرية

Semilunar Valves

يقع داخل جدران كلا البطينين

مباشرة قبل اتصال البطين

إلى الجذع الرئوي والشريان الأورطي

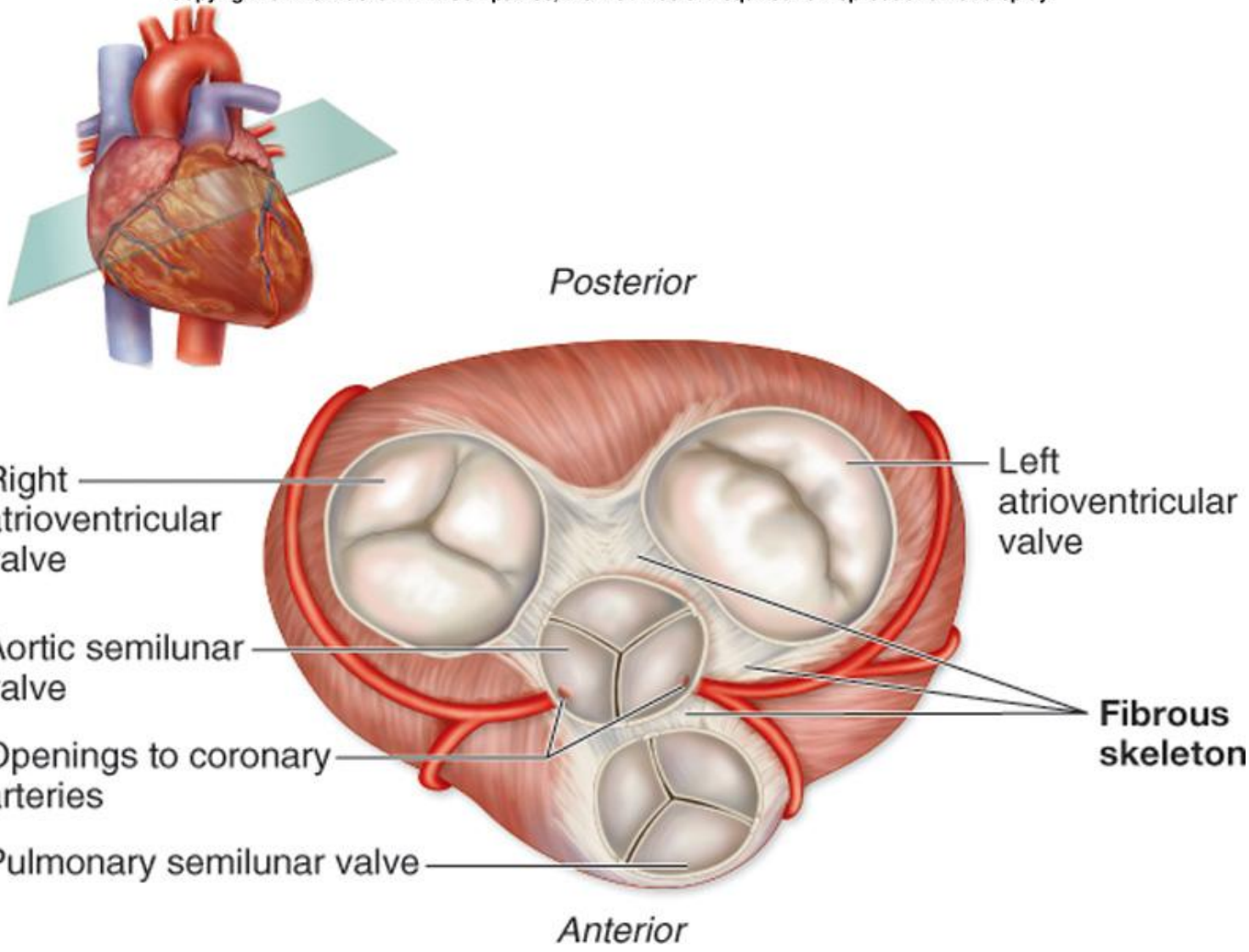
- Located within the walls of both ventricles immediately before the connection of the ventricle to the **pulmonary trunk** and **aorta**.
- Each is composed of three **semilunar cusps**.

عندما يتم ضخ الدم إلى جذوع الشرايين، فإنه

يدفع ضد القمم، مما يجبر الصمامات على الفتح.

- As blood is pumped into the arterial trunks, it pushes against the cusps, forcing the **valves open**.
- When ventricular contraction ceases, blood is prevented from flowing back into the ventricles.

Heart Valves



نظام التوصيل للقلب

Conduction System of the Heart

Sinoatrial (SA) Node

العقدة الجيبية الأذينية (SA)

يبدأ نبض القلب بواسطة ألياف عضلة القلب

- ✓ Heartbeat is initiated by the cardiac muscle fibers of the sinoatrial (SA) node.

العقدة الجيبية الأذينية (SA)

- ✓ located in the posterior wall of the right atrium, adjacent to the entrance of the superior vena cava

يقع في الجدار الخلفي للأذين الأيمن،

مجاور لمدخل الوريد الأجوف العلوي

العمل كجهاز تنظيم ضربات القلب

- ✓ Act as the **pacemaker**.

المركز الإيقاعي الذي يحدد وتيرة القلب

- ✓ **Rhythmic center** that establishes the pace for cardiac activity, initiates impulses 70 -90 times per minute

النشاط، يبدأ النبضات 70-90 مرة في الدقيقة

العقدة الأذينية البطينية (AV)

Atrioventricular (AV) Node

ينتقل الدافع إلى كلا الأذينين، مما يحفز الأذين

- Impulse travels to both atria, stimulating **atrial systole (contraction)**. انقباض (انقباض)

- via an **internodal conduction** pathway through an opening in the fibrous skeleton to the **atrioventricular (AV) node**.

عن طريق مسار التوصيل الداخلي من خلال

فتح في الهيكل العظمي الليفي إلى

العقدة الأذينية البطينية (AV)

- Cardiac impulse then travels from the AV node to the atrioventricular (AV) bundle(**bundle of His**) which extends into the interventricular septum and then divides into one right and two left bundle branches.

ثم ينتقل الدافع القلبي من العقدة AV إلى

حزمة الأذينية البطينية (AV) (حزمة له) التي

يمتد إلى الحاجز بين البطينين ثم

ينقسم إلى فرع حزمة يمين واحد وفرعين يساريين.

Atrioventricular (AV) Bundle

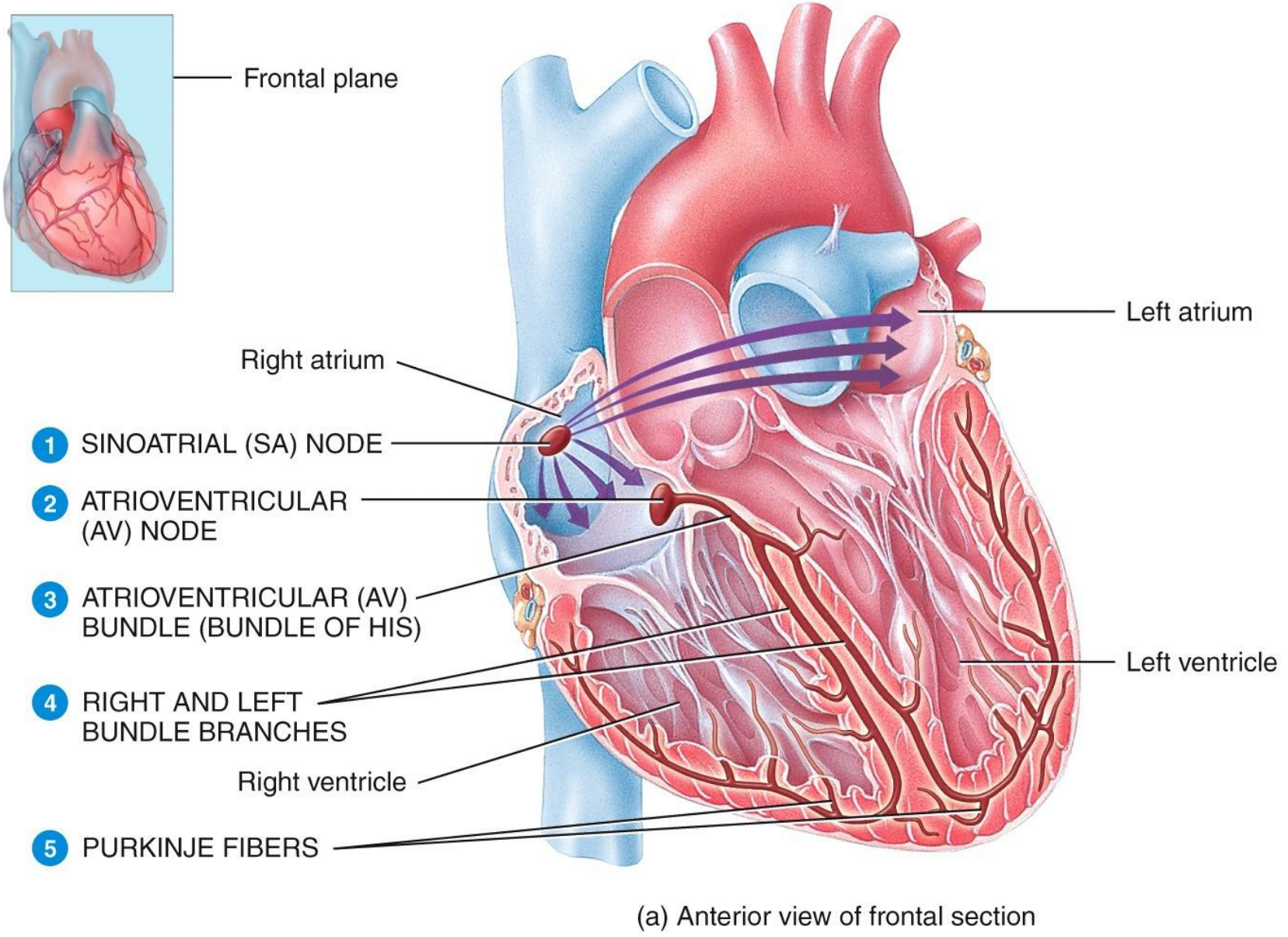
قم بتوصيل الدافع إلى ألياف التوصيل المسماة

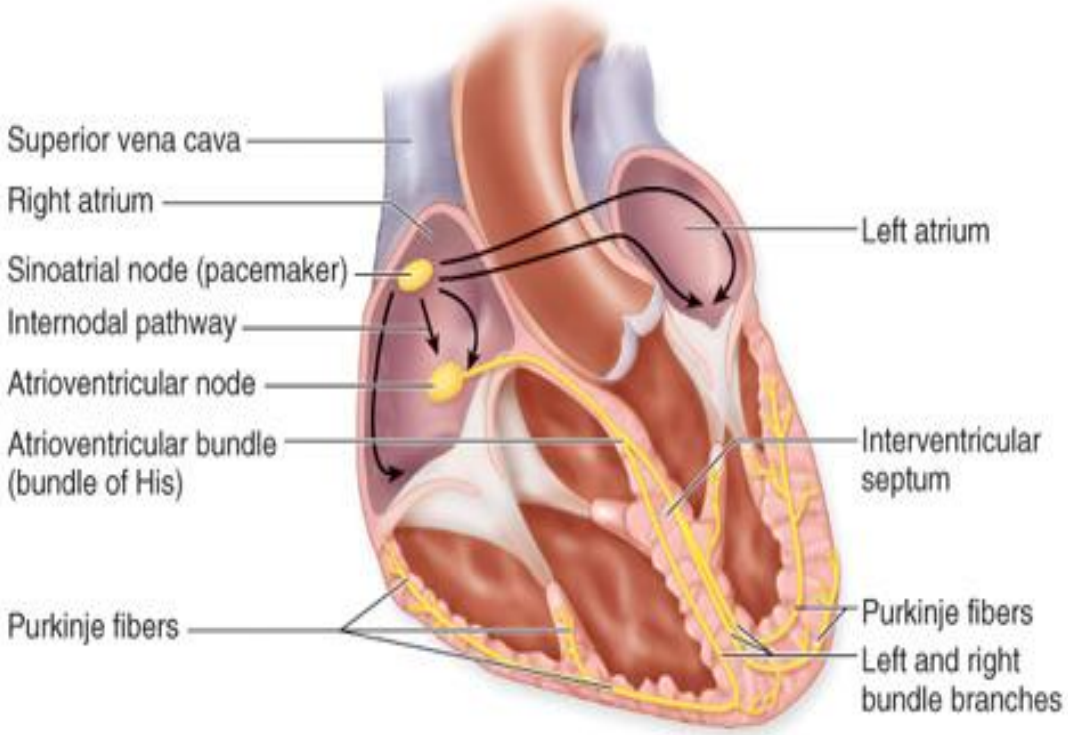
ألياف بوركيني في قمة القلب.

- Conduct the impulse to conduction fibers called **Purkinje fibers** in the heart apex.

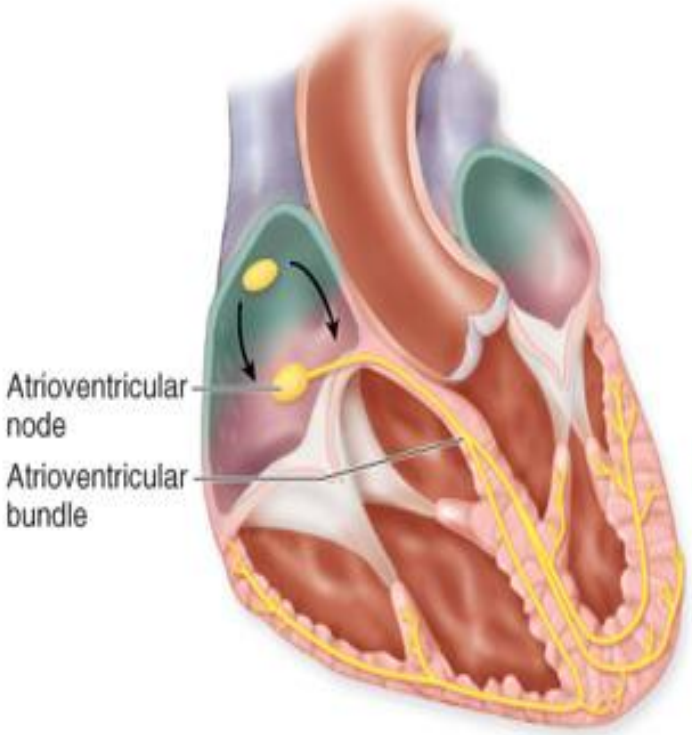
- Muscle impulse conduction along the Purkinje fibers is extremely rapid, consistent with the large size of the cells.

- The impulse spreads immediately throughout the ventricular myocardium.

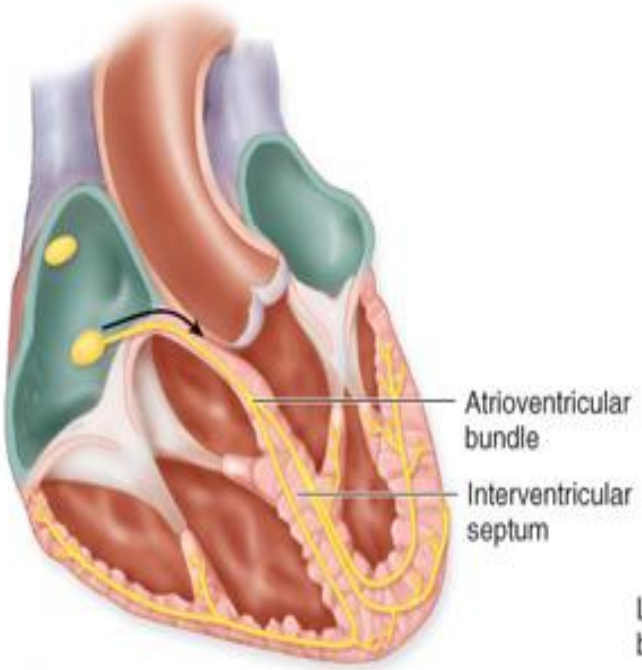

Frontal plane
Left atrium
Right atrium
1 SINOATRIAL (SA) NODE
2 ATRIOVENTRICULAR (AV) NODE
3 ATRIOVENTRICULAR (AV) BUNDLE (BUNDLE OF HIS)
Left ventricle
4 RIGHT AND LEFT BUNDLE BRANCHES
Right ventricle
5 PURKINJE FIBERS
(a) Anterior view of frontal section



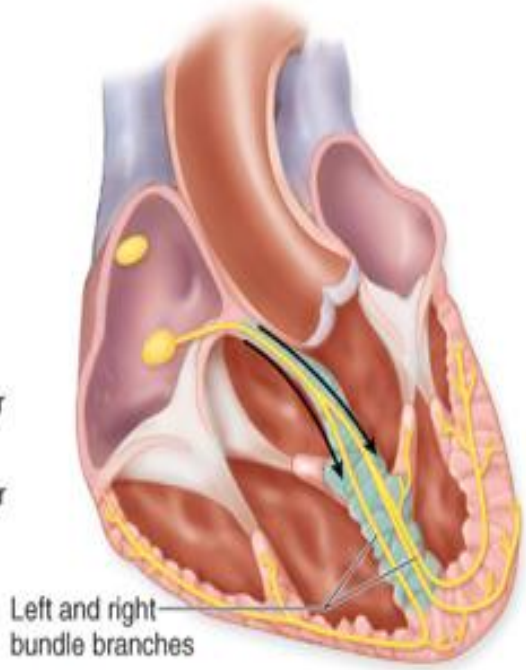
(1) Muscle impulse is generated at the sinoatrial node. It spreads throughout the atria and to the atrioventricular node.



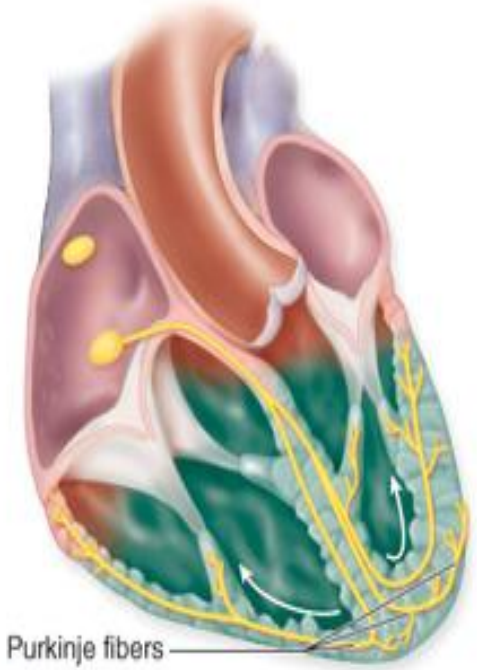
(2) Atrioventricular node fibers delay the muscle impulse as it passes to the atrioventricular bundle.



(3) The atrioventricular bundle (bundle of His) conducts the muscle impulse into the interventricular septum.



(4) Within the interventricular septum, bundle branches split from the atrioventricular bundle.



(5) The muscle impulse is delivered to Purkinje fibers in each ventricle and distributed throughout the ventricular myocardium.

SA Node → atrial systole & internodal conduction → AV node → bundle of His → Purkinje fibers → ventricular myocardium

BLOOD VESSELS

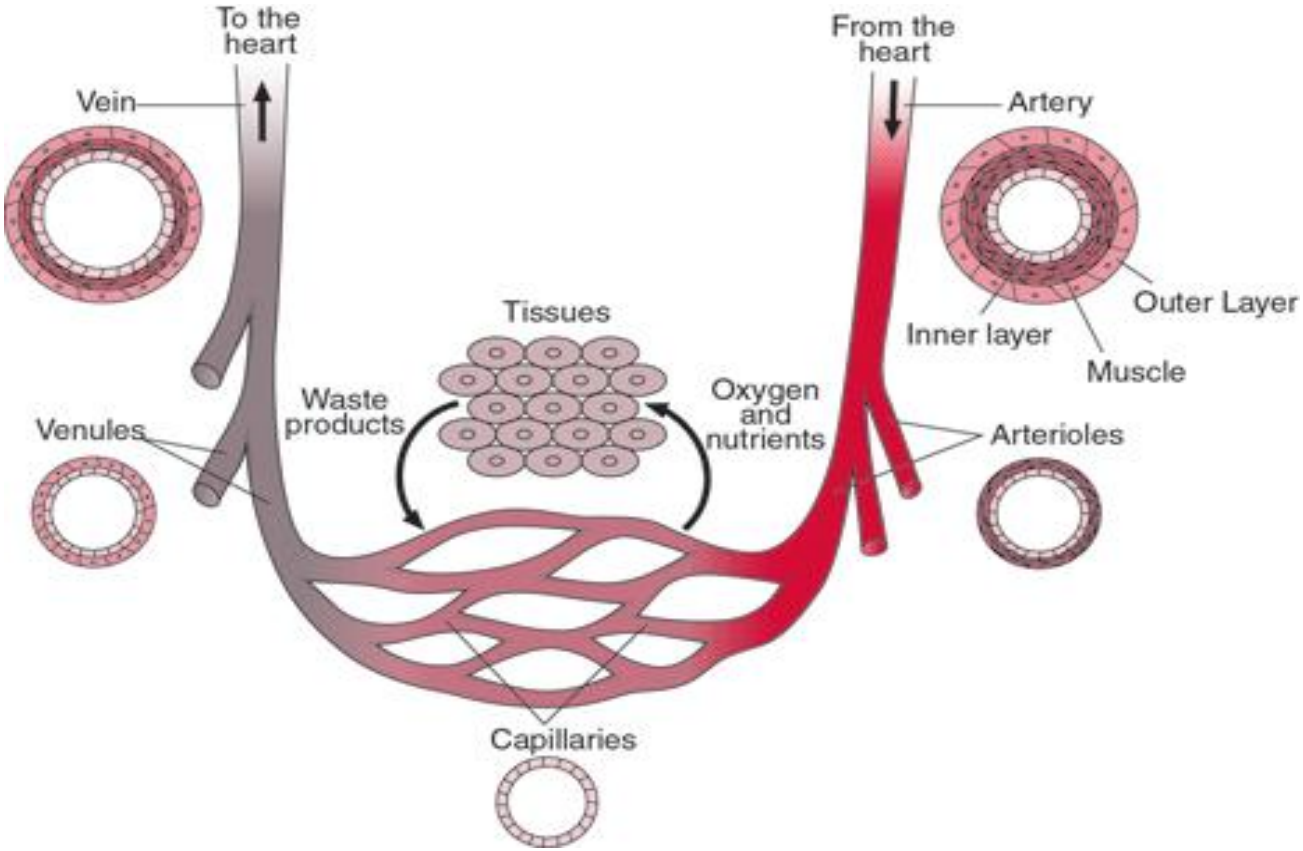
Hamza Abu Hilail
M.Sc. Physiology

Blood Vessels: The Vascular System

Taking blood to the tissues and back

- Arteries
- Arterioles
- Capillaries
- Venules
- Veins

Blood Vessels



- Heart → Arteries → Arterioles → Capillaries → venules → veins

الاختلافات بين الشريان والوريد

Differences Between Artery & Vein

1. Wall thickness
2. Lumen diameter قطر التجويف
3. Presence of valves وجود الصمامات
4. Type of blood carried by each vessel
5. Location of arteries and veins within the body

Differences Between Blood Vessel Types

الاختلافات بين الأوعية الدموية

أنواع

- **Walls** of arteries are the thickest

تجويف الأوردة أكبر

- **Lumens** of veins are larger

العضلات الهيكلية "تحلب" الدم في الأوردة نحو القلب

- Skeletal muscle "**milks**" blood in veins toward the heart

جدران الشعيرات الدموية هي طبقة خلية واحدة فقط سميكة إلى السماح بالتبادل بين الدم والأنسجة

- **Walls of capillaries** are only one cell layer thick to allow for exchanges between blood and tissue

Blood vessels

- As the arterioles enter a tissue → the numerous tiny vessels called **capillaries**
- **Thin walls** of capillaries allow the exchange of substances between the blood and body tissues.
- Groups of capillaries within a tissue reunite to form small veins called **venules**
- **Venule** merge to form progressively larger blood vessels called **veins**.
- **Veins** are the blood vessels that convey blood from the tissues back to the heart

الأوردة هي الأوعية الدموية التي تنقل الدم من الأنسجة

العودة إلى القلب

Basic structure of a blood vessel

يتكون جدار الوعاء الدموي من

ثلاث طبقات، أو الستر المختلفة

- The wall of a blood vessel consists of **three layers, or tunics** of different tissues: مناديل

1) **Endothelial** inner lining البطانة
2) **Smooth muscle** of the middle layer العضلات الملساء
3) **Elastic connective tissue** النسيج الضام المرن
4) **connective tissue** outer covering

Basic structure of a blood vessel

الطبقات الهيكلية الثلاث المعممة

الأوعية الدموية من الأعمق إلى الأبعد

- The three structural layers of a generalized blood vessel from **innermost to outermost**:

1. **Tunica interna** (intima)
2. **Tunica media**
3. **Tunica externa** (adventia)

Three layers (tunics)

1. Tunic intima

The inner lining of a blood vessel

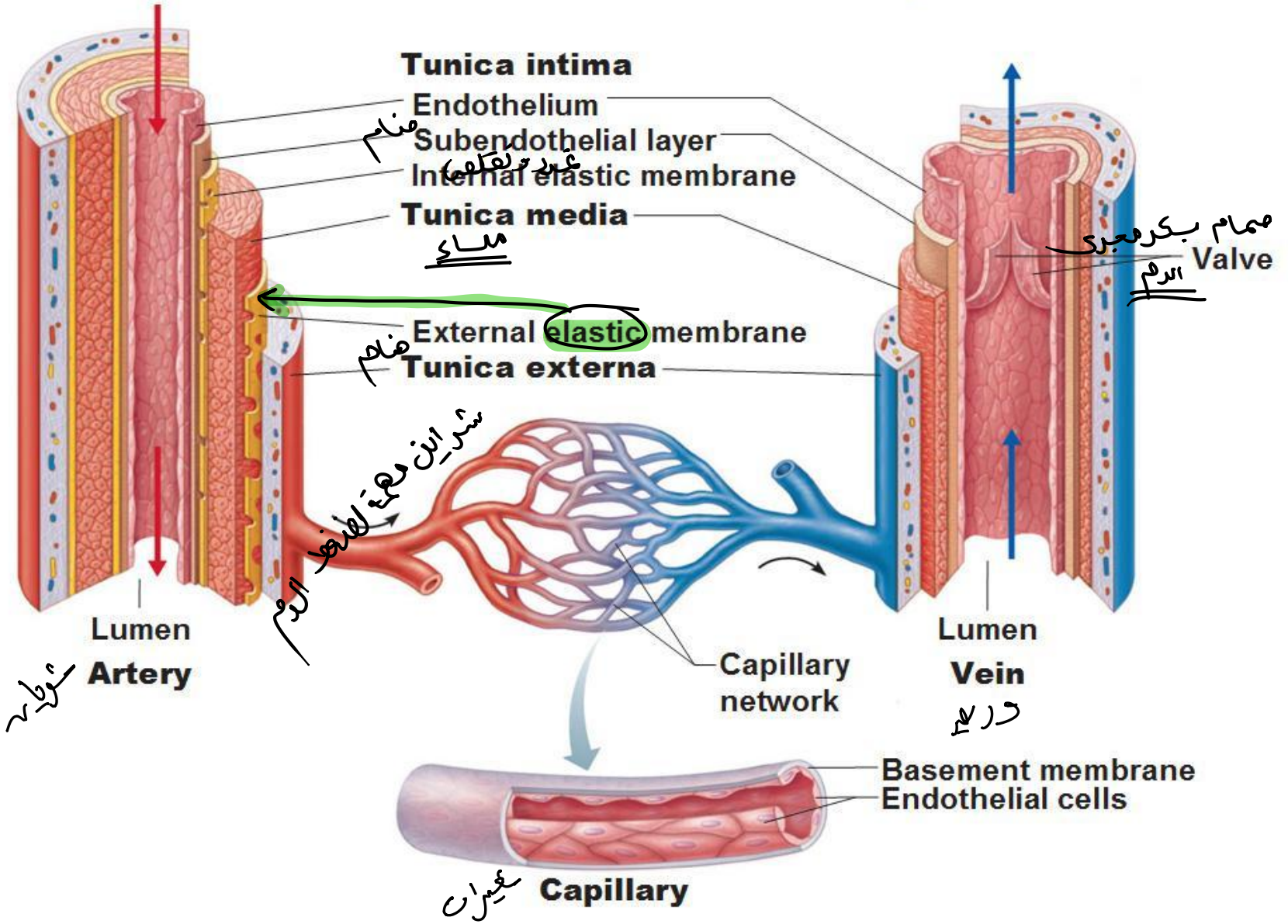
2. Smooth muscle

Controlled by sympathetic nervous system

3. Tunic externa

Mostly fibrous connective tissue

Structure of Blood Vessels – 3 Layers "Tunics"



توسع الأوعية/تضيق الأوعية

Vasodilation/Vasoconstriction

1. sympathetic stimulation **decreases**
2. presence of certain **chemicals** (such as nitric oxide, H, and lactic acid)
3. response to **blood pressure**

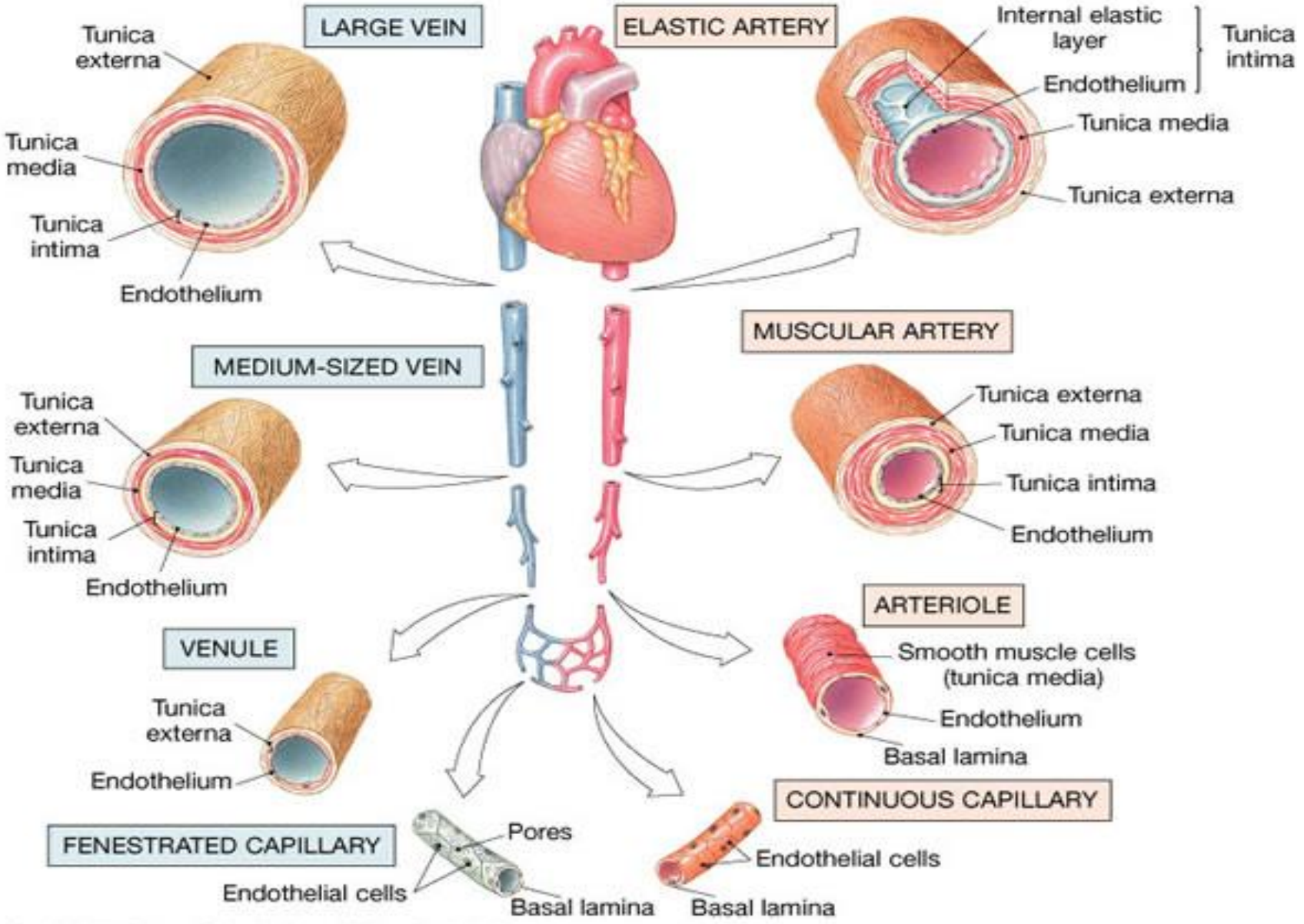
smooth muscle fibers relax→ increase in lumen diameter → **vasodilation** توسع الأوعية

صغر الضغط الدم

- An **increase** in sympathetic stimulation typically stimulates the smooth muscle to contract, squeezing the vessel wall and narrowing the lumen→ **vasoconstriction**

زيادة في التحفيز الودي عادة
يحفز العضلات الملساء على الانقباض، ويضغط على جدار الوعاء وتضييق التجويف→
تضيق الأوعية

زيادة ضغط الدم



Anastomosis

- Most tissues of the body receive blood from more than one artery.

مفاغرة: هي اتحاد فروع

شريانان أو أكثر يزودان نفس الجسم

- **Anastomosis**: is the union of the branches of two or more arteries supplying the same body region

منطقة

توفر مفاغرة بين الشرايين

طرق بديلة للدم للوصول إلى الأنسجة أو

- Anastomoses between arteries provide alternative routes for blood to reach a tissue or organ.

عضو.

Anastomosis

- If blood flow stops for a short time when normal if a vessel is blocked by disease, injury, or surgery, then circulation to a part of the body **is not necessarily stopped.**

الطريق البديل لتدفق الدم إلى جزء من الجسم

من خلال مفاغرة تعرف باسم الضمان

- The alternative route of blood flow to a body part through an anastomosis is known as **collateral circulation.**

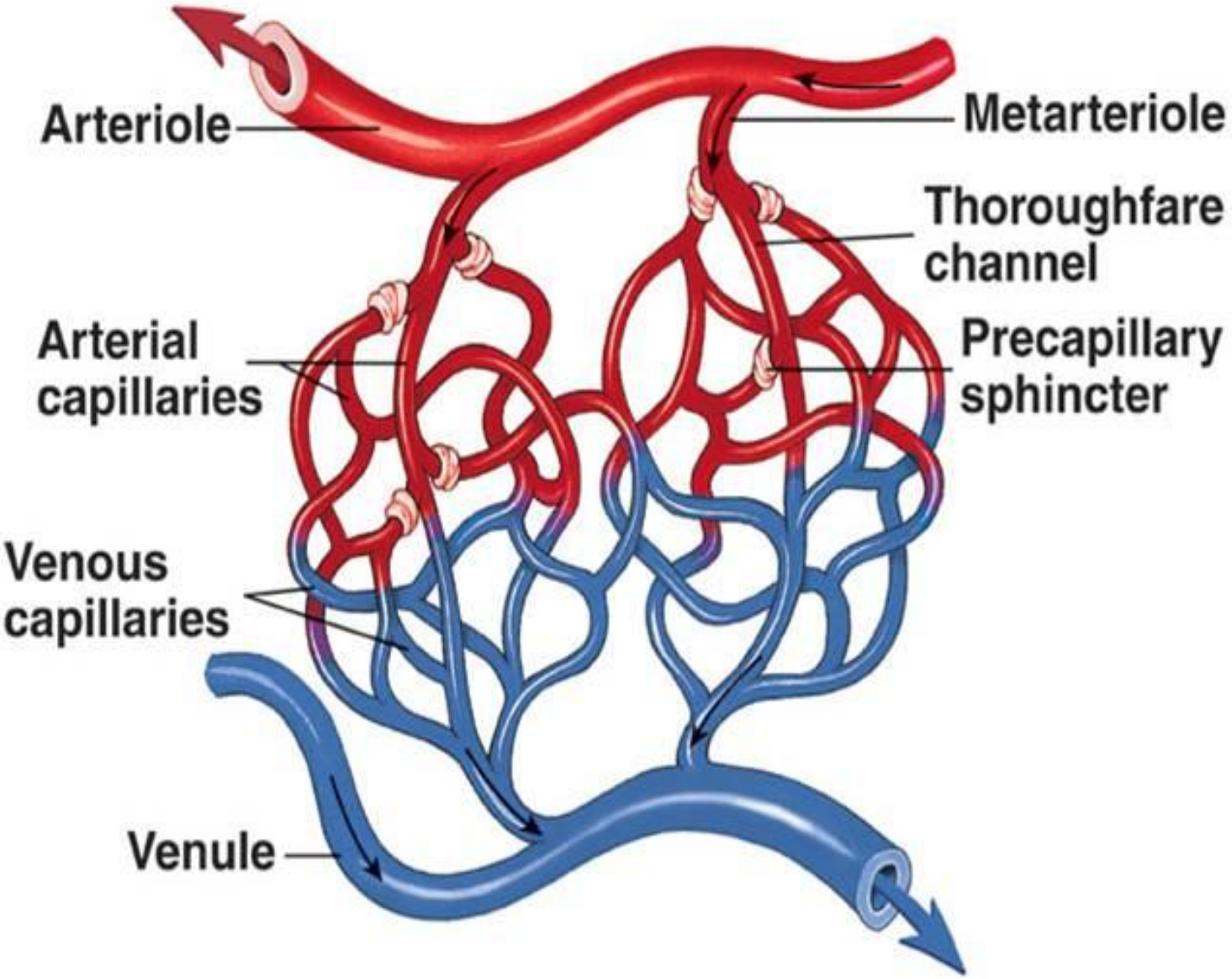
دوران

- Anastomoses may also occur between veins and between arterioles and venules.

أوردة

شرايين

أوردة


Arteriole
Metarteriole
Thoroughfare channel
Arterial capillaries
Precapillary sphincter
Venous capillaries
Venule

Arterioles

- Contraction of smooth muscle of an arteriole → increase resistance → increase blood pressure (BP)

- Relaxation of smooth muscle → decrease resistance → decrease BP

Capillaries

أصغر من الأوعية الدموية

- The smallest of blood vessels, called **exchange vessels**
- have diameters of 5–10 μm,
- Connect the arterial outflow to the venous return.
- Capillaries form an extensive network, short, branched, interconnecting vessels that course among the individual cells of the body

قم بتوصيل التدفق الشرياني بالعودة الوريدية

تشكل الشعيرات الدموية شبكة واسعة، قصيرة، السفن المتفرعة والمترابطة التي تسير بين الخلايا الفردية للجسم

Capillary Structure

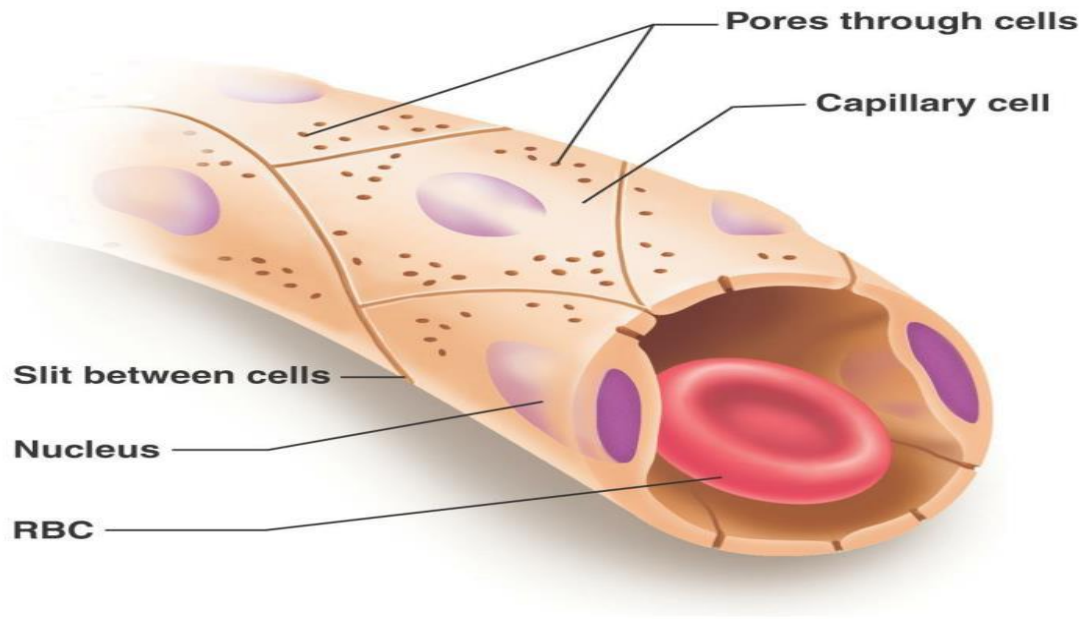
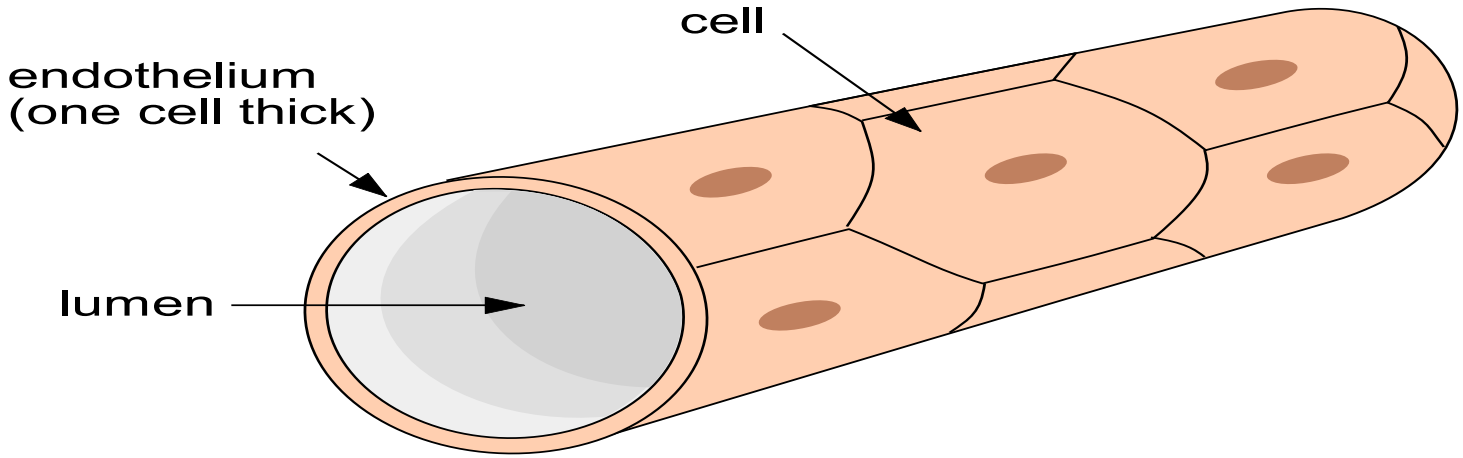


Figure 8.4



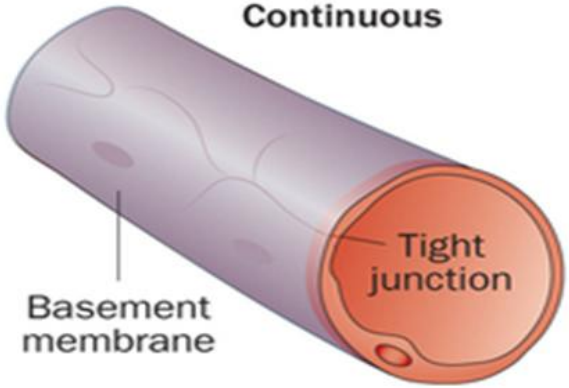
Types of Capillaries

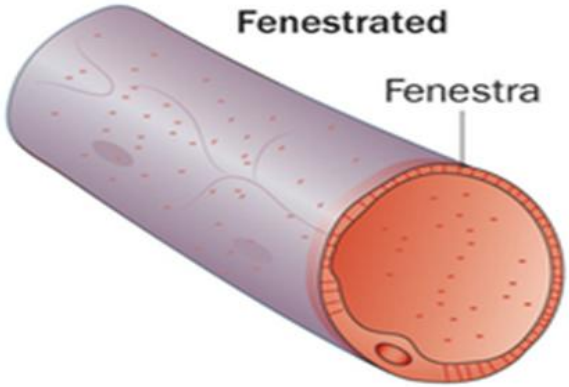
1. Continuous Capillaries

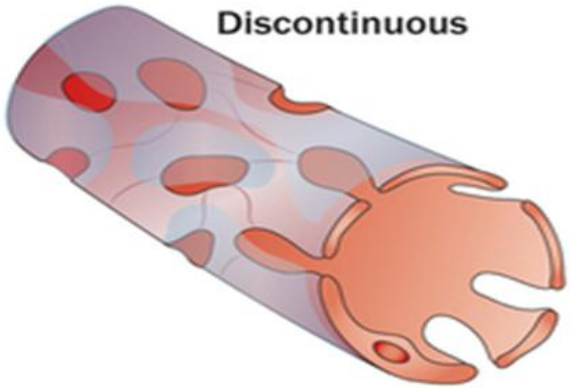
الشعيرات الدموية المنفتحة

2. Fenestrated Capillaries

3. Sinusoid







Organ	Function
* جدرانها متصلة	
CNS ← جهاز عصبي مركزي	Blood → BBB → Brain Barrier
Lymph node العقدة اللمفاوية	خلايا لمفاوية Lymphocyte homing
Muscle العضلات	Metabolic exchange تبادل المواد الأيضية
* فيها ثقوب	
Endocrine glands غدة صماء	Secretion إفراز
Gastrointestinal tract قناة هضمية	Absorption امتصاص
Choroid plexus ← في الدماغ	Secretion
Kidney glomeruli الكلية	Filtration ترشيح
* فيها فتحات واسعة	
Liver كبد	تبادل الجزيئات الكبيرة Particle exchange
Bone marrow نخاع العظم	Haematopoiesis تكوين خلايا الدم
Spleen طحال	Blood cell filter تصفية خلايا الدم

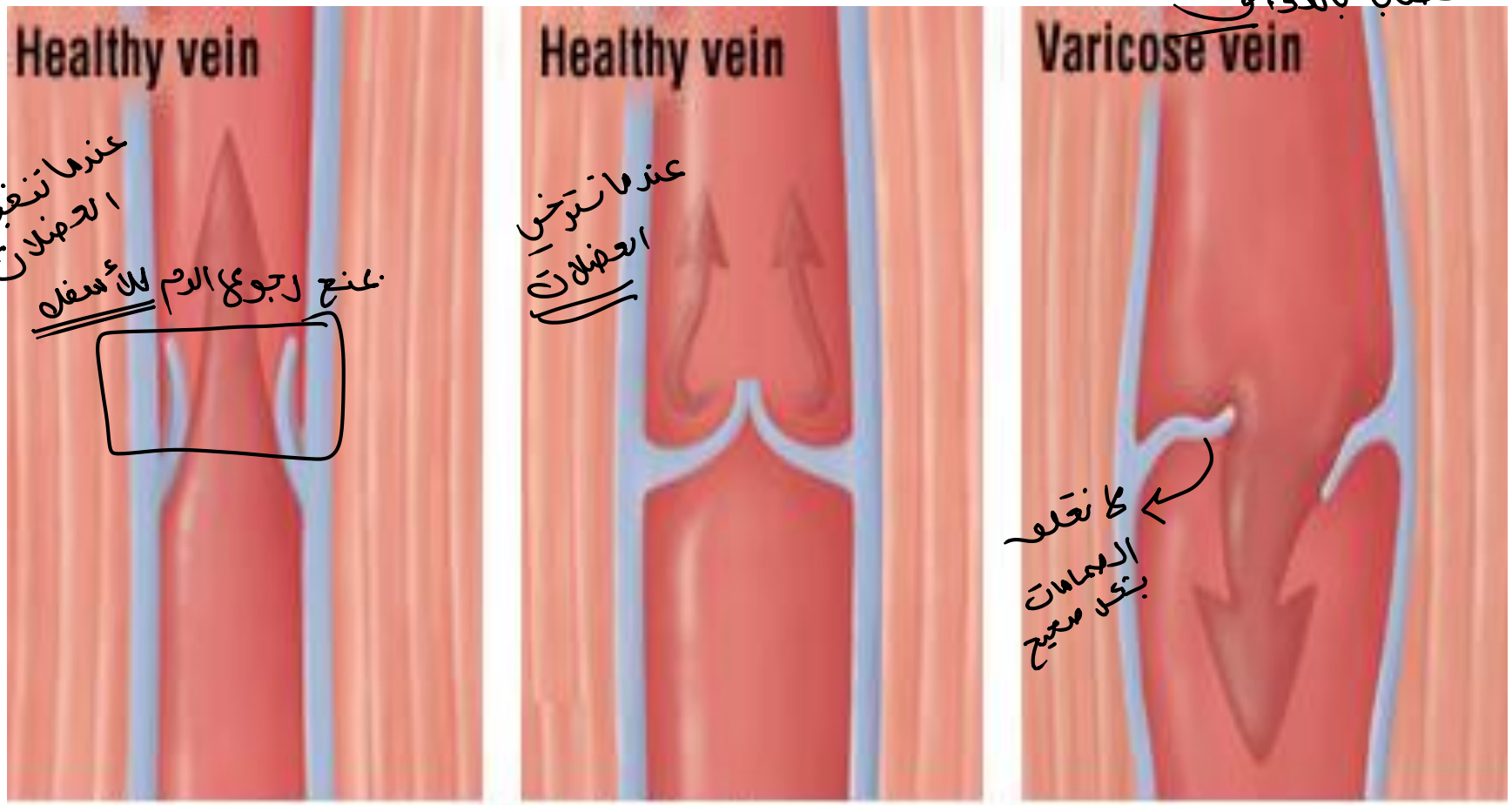
عروق

Veins

- Return blood back to the heart
- Wall is thinner than that of an artery شريان
- Wall contains less elastic tissue
- Contains valves aiding in venous return by preventing backflow of blood
- Veins have lower pressure than arteries

الجيوب الأنفية الوريدية: وريد ذو جدار بطانة رقيق لا يحتوي على العضلات الملساء لتغيير قطرها (مثل الجيوب الأنفية التاجية)

- **Venous sinus**: a vein with a thin endothelial wall that has no smooth muscle to alter its diameter (e.g coronary sinus)



Valve opens as muscles squeeze vein, blood moves upward

Valve closes as muscles relax, blood cannot leak downward

Valves don't close properly, blood leaks downward

THE BLOOD

Hamza Abu Hilail
M.Sc. Physiology

Functions of the blood

1. Transport of substances: Oxygen, CO2, nutrients, waste, heat, and hormones
2. Maintenance of normal Ph
3. Maintenance of normal body fluid volume

الحفاظ على التوازن

4. Maintain homeostasis

محاربة العدوى

5. Fight infection

Blood

- Blood constitutes about **8%** of body weight.
- Blood volume ranges from **4 to 6 liters** (slightly over 1 gallon).
- The pH range of blood is **7.35-7.45.**

يتم تصبغ الدم بواسطة الهيموغلوبين في كريات الدم الحمراء

- Blood is **pigmented by** hemoglobin in erythrocytes

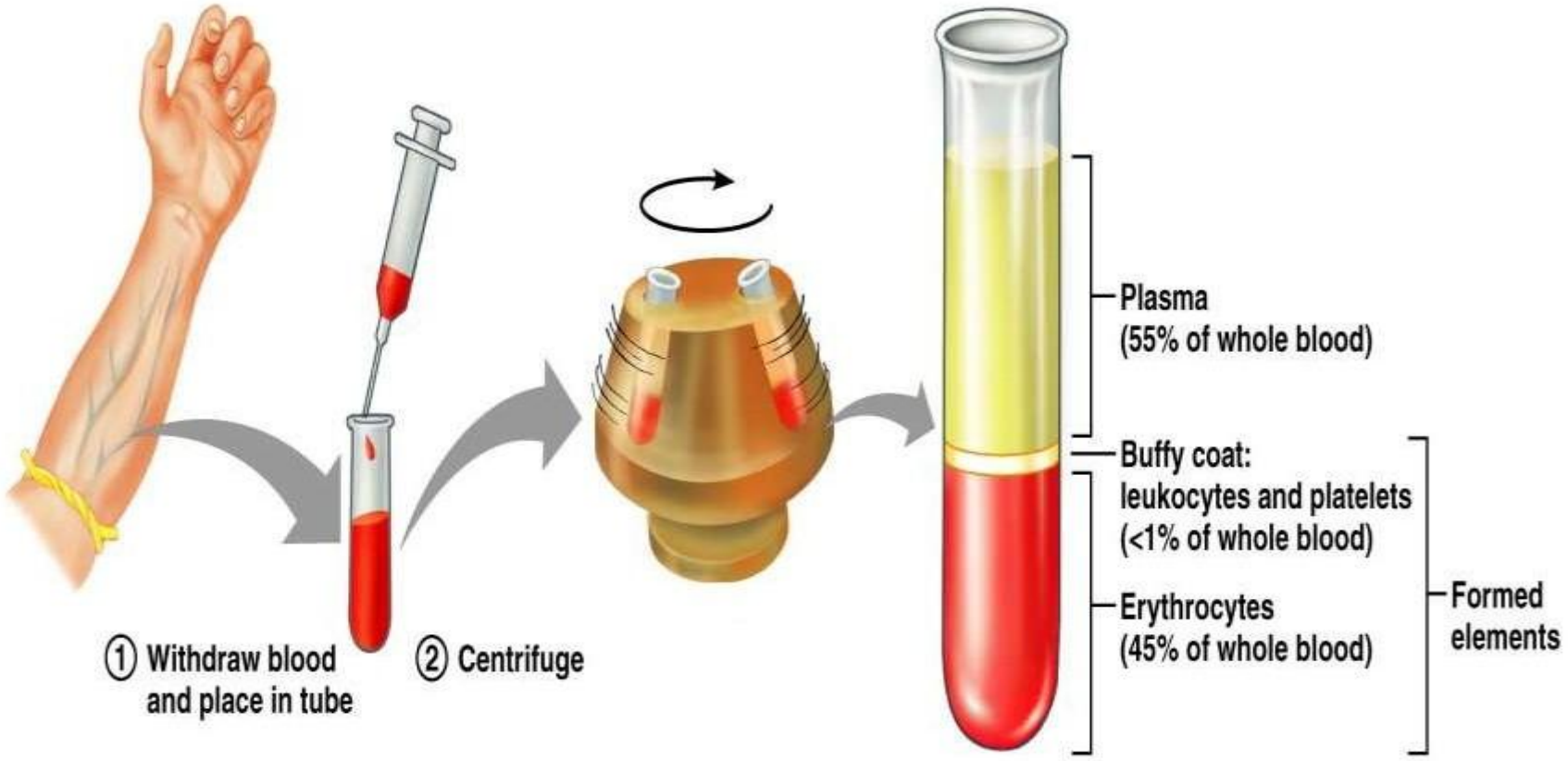
يتحول الدم إلى اللون الأحمر عندما يرتبط الهيموغلوبين ب O2

- Blood turns red when hemoglobin **binds with O2**

يتحول الدم إلى اللون الأحمر الداكن أو الأزرق عندما يرتبط الهيموغلوبين ب ثاني أكسيد الكربون

- Blood turns dark red or blue when hemoglobin **binds with CO2**

Chemical composition of blood



Blood

- Blood consists of 55% plasma and 45% hematocrits

- **The plasma contains**: H2O, proteins, electrolytes, hormones, and nutrients

The Haematocrits consist of:

1. Red blood cells
2. White blood cells
3. platelets

sources

- The source of **plasma water** is ingested H2O.
- The source of **plasma protein** is the liver.
- The source of **blood cells** is the bone marrow.

1. **Primary**: In adults, blood cells are formed by the **red bone marrow**, the primary source is the marrow in the sternum, ribs, vertebrae, skull, and pelvis.
2. **Secondary**: Blood cells can be formed by **the marrow in the femur & Tibia** (if necessary)
3. **Tertiary**: In excessive blood loss, the blood cells can be formed in **the liver and spleen**. In the embryo, these organs are the primary source of blood cells.

Erythrocytes (Red Blood Cells)

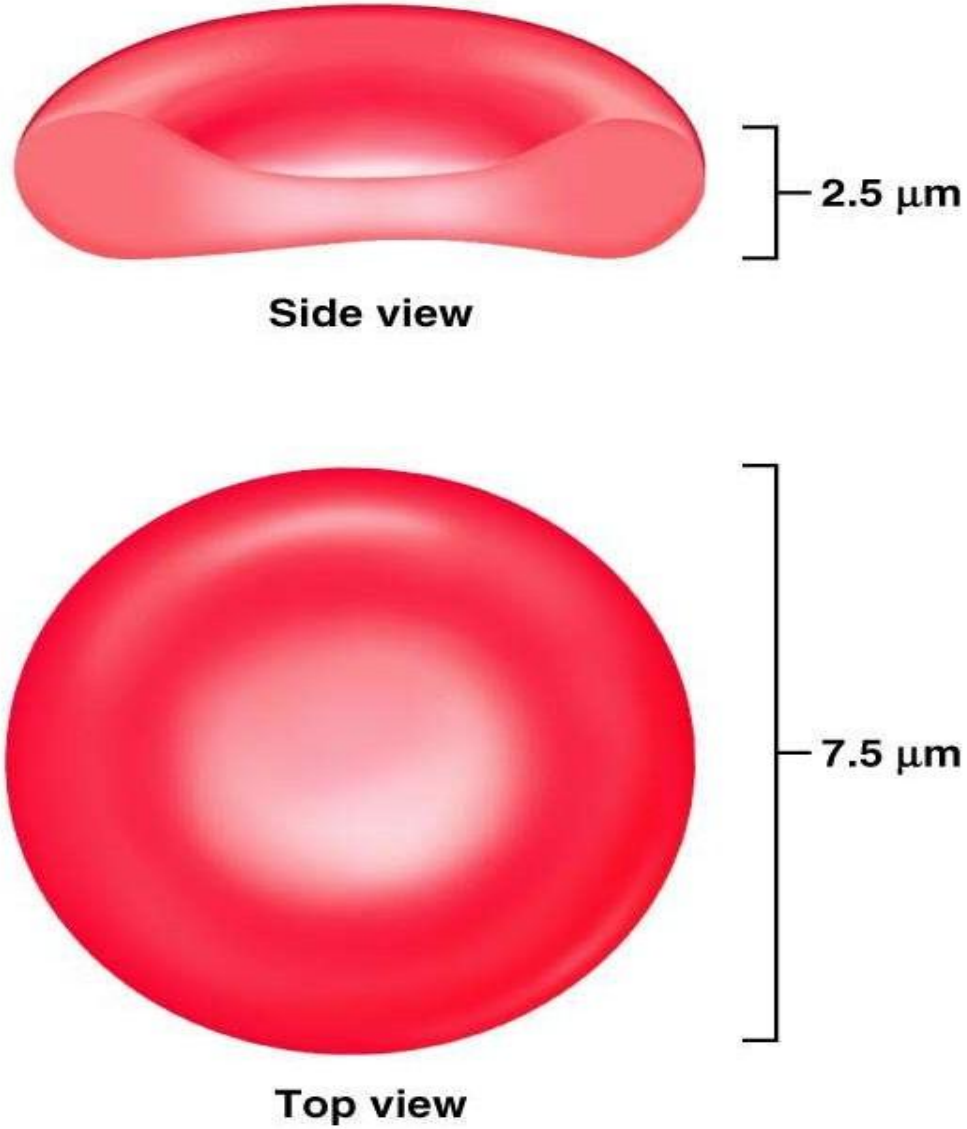
- Blood cells specialized in delivering oxygen to tissue cells, using a protein called hemoglobin

- Small (7.5 µm in diameter), **round, biconcave** shaped (from the side view), and **lacking a nucleus**

The biconcave shape in RBC is thought to:

1. Allow RBC to slip through capillaries
2. More effectively provide a larger surface area for the diffusion of gases
3. Allow hemoglobin to be closer to the cell membrane of RBC

Erythrocytes (Red Blood Cells)



Erythrocytes (Red Blood Cells)

- RBCs do not reproduce using mitosis during their short **life span of 120 days**.
- **RBC increases after:** exercising, after a large meal, When a person is at high altitudes, or when body temperature rises
- Nutritional factors in the diet are critical in the formation of RBC (vitamin B-12, folic acid, and iron)
- The hormone **Erythropoietin** from the kidney stimulates RBC production from the bone marrow

Red Blood Cells Cycle

عندما تمر RBC خلال capillaries الشعيرات الدموية، تتعرض للتلف بسبب الاحتكاك

1. Squeezing through the capillaries of active tissues damages red blood cells

2. Macrophages (الضمة) in the liver (كبد) & spleen (طحال) phagocytize damaged red blood cells

3. Hemoglobin from the red blood cells is decomposed into **heme and globin** (1) (2)

4. Heme is decomposed into **iron** and **biliverdin**

يتحول لاحقاً إلى Bilirubin الذي يفرز الصفراء

Red Blood Cells Cycle

5. **Iron** is made available for reuse in the synthesis of new hemoglobin or is stored in the liver as **ferritin**

6. Some biliverdin is converted into bilirubin

7. Biliverdin and bilirubin are excreted in bile as bile pigments

- High bilirubin may indicate liver or biliary disease

WBC

Leukocytes

- Constitute less than 0.1% of all blood cells in formed elements
- Spherical, slightly larger than erythrocytes, generally function in the lymphatic system for body defenses
- They were divided into 2 groups based on the presence of granules in the cytoplasm: الخلايا الحبيبية (خلايا الدم البيضاء التي تحتوي على حبيبات في السيتوبلازم مع نواتها مقسمة إلى فصوص)

1. **Granulocytes (**WBCs that contain granules in their cytoplasm with their nuclei divided into lobes)

Leukocytes

2. Agranulocytes (WBCs that lack granules in their cytoplasm).

The Granulocytes include:

1. Neutrophils (54- 62% of all WBC) → خط دفاع أولي
2. Eosinophils (1-3%)
3. Basophils (0.4-1%)

→ للالتهاب والحساسية

The None Granulocytes include:

1. Lymphocytes (25-33%)
2. Monocytes (3-9%).

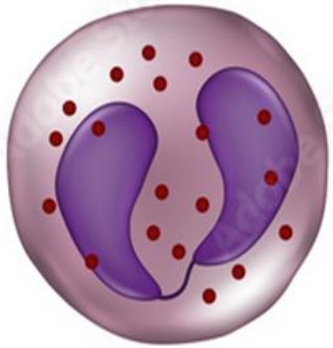
→ بلعمة أو تبلع الخلايا الحية

كل وحدة إلها وظيفة

White blood cells

Neutrophil

خط دفاع أول

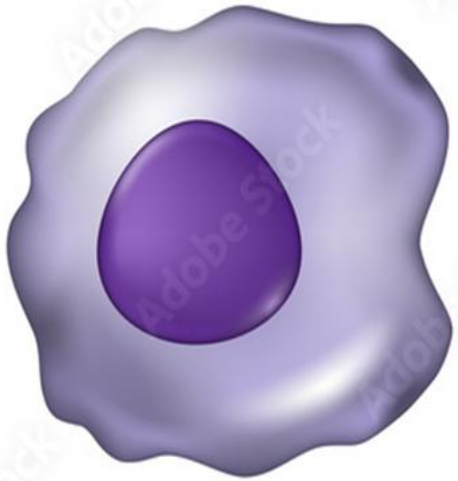


Eosinophil

Basophil

Monocyte

Lymphocyte



Macrophage

Leukocytes

هي الكريات البيض التي يمكن أن تبتلع الأجانب

مواد لأغراض الدفاع عن الجسم

- **Phagocytes:** are leukocytes that can engulf foreign substances for body defense purposes

The main types of phagocytes are:

1. Monocytes
2. Macrophages
3. Neutrophils

تتطور الخلايا الوحيدة إلى البلاعم و

السفر لمسافات أطول للعثور على مواد غريبة

- **The Monocytes** develop into **Macrophages** and travel longer distances to find foreign substances

Functions of WBCs

هي دفاع مضيف فطري ضد معظم البكتيريا والفطريات

1. Neutrophils

مسببات الأمراض

✓ are innate host defense against most **bacterial and fungal pathogens**

تلعب دورا مهما في الالتهاب المتعلق ب

2. Eosinophils

حساسية

✓ play a significant role in the inflammation related to allergies

يمكن أن يساعد في اكتشاف وتدمير بعض الخلايا السرطانية المبكرة

✓ يمكن إطلاق الهيستامين في حبيباته أثناء

3. Basophils

رد الفعل التحسسي (ردود الفعل التحسسية)

✓ Can help detect and destroy some early <u>cancer cells</u>

✓ Can release the histamine in their granules during an allergic reaction (Allergic reactions)

Functions of WBCs

تحيط وتقتل الكائنات الحية الدقيقة، وتبتلع الغريبة

المواد، وإزالة الخلايا الميتة، وتعزيز المناعة

ردود

3. Monocytes

- ✓ surround and kill microorganisms, ingest foreign material, remove dead cells, and boost immune responses

إنتاج جزيئات الأجسام المضادة التي يمكن أن تتشبث و

تدمير الفيروسات أو البكتيريا الغازية

4. Lymphocytes

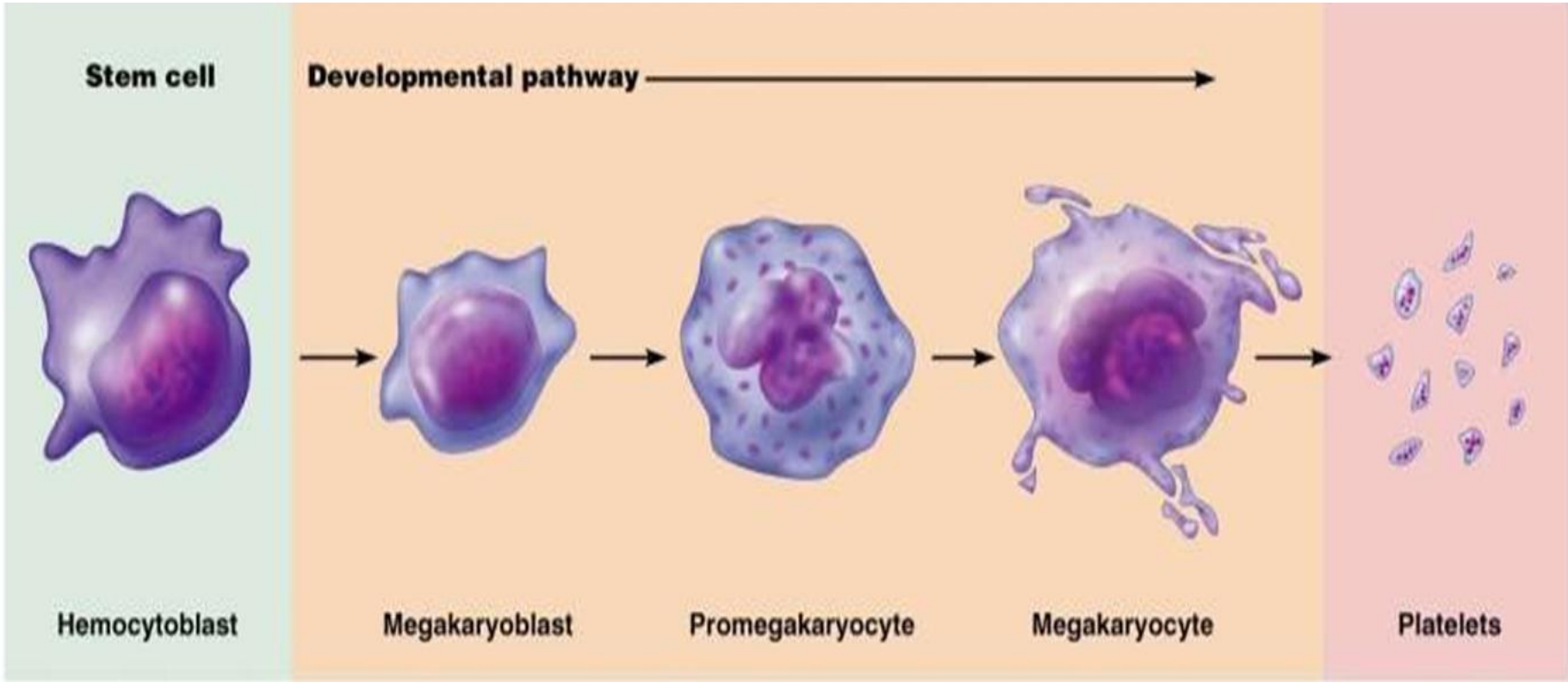
- ✓ Produce antibody molecules that can latch on and destroy invading viruses or bacteria

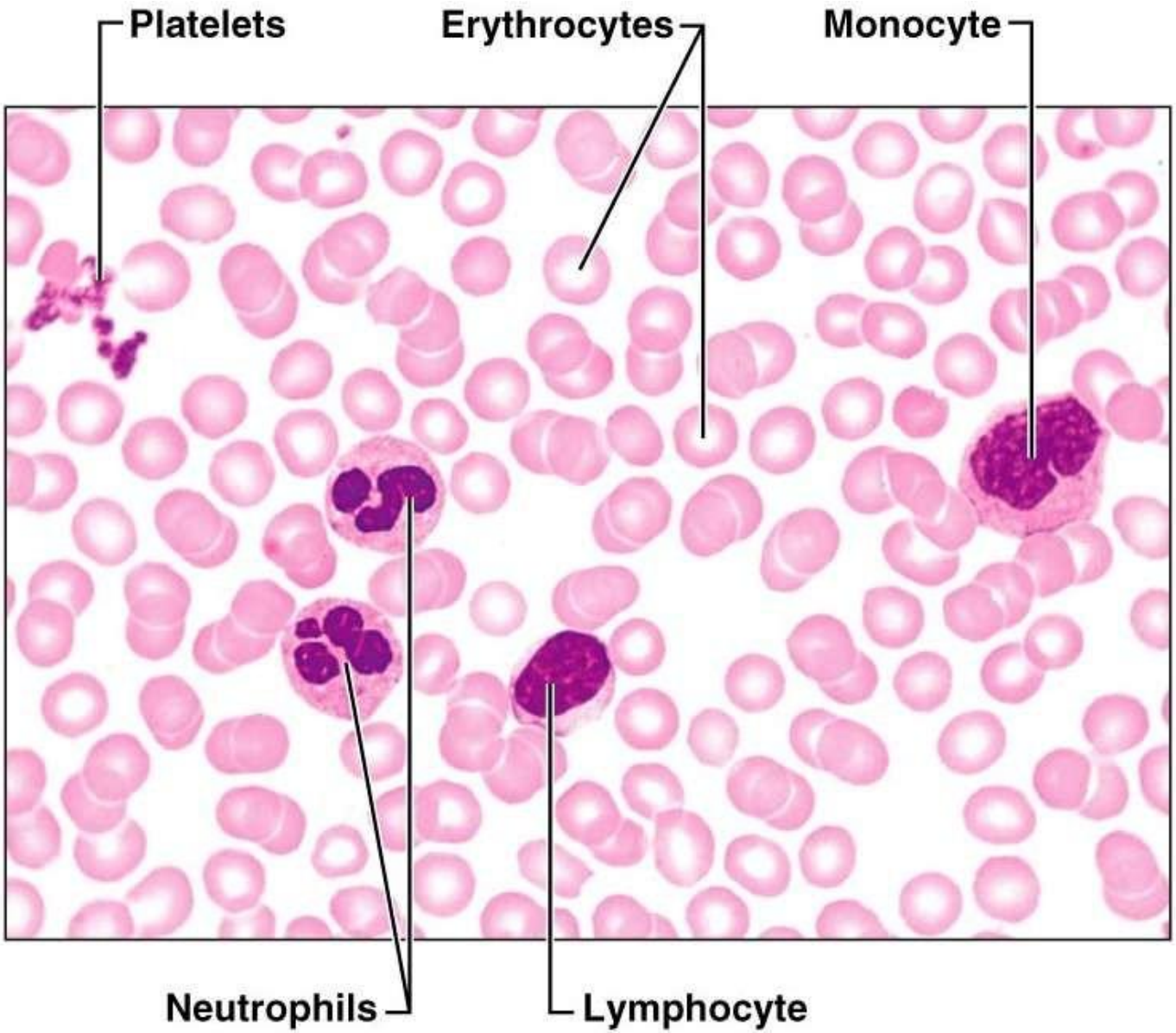
الصفائح الدموية (الصفائح الدموية)

Thrombocytes (platelets)

- Platelets (thrombocytes) are colorless blood cells that help blood clot.
- **Platelets stop bleeding** by clumping and forming plugs in blood vessel injuries
- Averaged life span is **5-9 days**
- **Normal range** is 130,000-360,000 /mm3

Thrombocytes (platelets)




Platelets
Erythrocytes
Monocyte
Neutrophils
Lymphocyte

LDL & HDL

Very low-density lipoproteins (VLDL)

الدهون الثلاثية

- ✓ Have a high amount of triglyceride
- ✓ It transports triglycerides synthesized in the liver from carbohydrates to adipose cells (bad cholesterol)

الخلايا الدهنية

- ✓ If the VLDL levels are low, it generally indicates a positive health outcome (2 to 30 mg/dL)

Low-density lipoproteins (LDL)

- ✓ Have a high amount of cholesterol and makes up most of the cholesterol in the body
- ✓ Delivers cholesterol to various cells, including liver cells (bad cholesterol)
- ✓ The optimal range of LDL is (less than 100 mg/dL)

HDL

- HDL (high-density lipoprotein), called “good” cholesterol, absorbs cholesterol in the blood and carries it back to the liver
- The liver then flushes it from the body by converting the cholesterol to bile salts
- High levels of HDL cholesterol can lower the risk for heart disease and stroke

HDL

Characteristics:

- ❑ Relatively high concentration of protein and low concentration of lipids

يبدو أن نسبة أعلى من الكوليسترول الجيد إلى الكوليسترول الضار

تمنع تكوين البلاك وتقلل من خطر الإصابة بالقلب

- A higher ratio of HDL to LDL cholesterol appears to inhibit plaque formation and lower the risk of heart disease

مرض

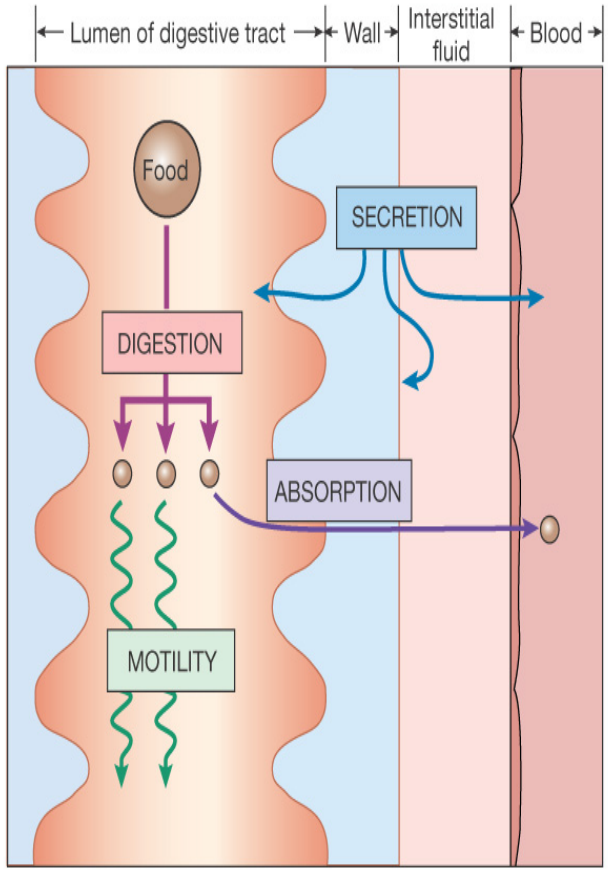
- **Normal range of HDL**: 35 to 65 mg/dL for men, 35 to 80 mg/dL for women

THE DIGESTIVE SYSTEM

Hamza Abu Hilail
M.Sc. Physiology

Function of the digestive system

- **Ingestion**: taking food and liquid into the mouth
- **Secretion**: a total of about 7 liters into the lumen
- **Mixing and propulsion**: through GI muscle and peristalsis and motility
- **Digestion**: Breakdown of ingested food (mechanical and chemical)
- **Absorption**: Passage of nutrients into the blood
- **Defecation**: waste substances leave the GI tract through the anus



الابتلاع: تناول الطعام والسوائل

في الفم

· الإفراز: ما مجموعه حوالي 7 لترات

في التجويف

· الخلط والدفع: من خلال

عضلة الجهاز الهضمي والتمعج و

حركة

· الهضم: انهيار المبتلع

طعام (ميكانيكي وكيميائي)

· الامتصاص: مرور العناصر الغذائية

في الدم

· التغوط: تغادر النفايات

الجهاز الهضمي من خلال فتحة الشرج

Organs of the Digestive System

Two main groups

- **Alimentary canal** or **gastrointestinal tract** continuous coiled hollow tube from mouth to anus(5-7 meter)

القناة الهضمية أو الجهاز الهضمي

أنبوب مجوف ملفوف مستمر من الفم

إلى فتحة الشرج (5-7 أمتار

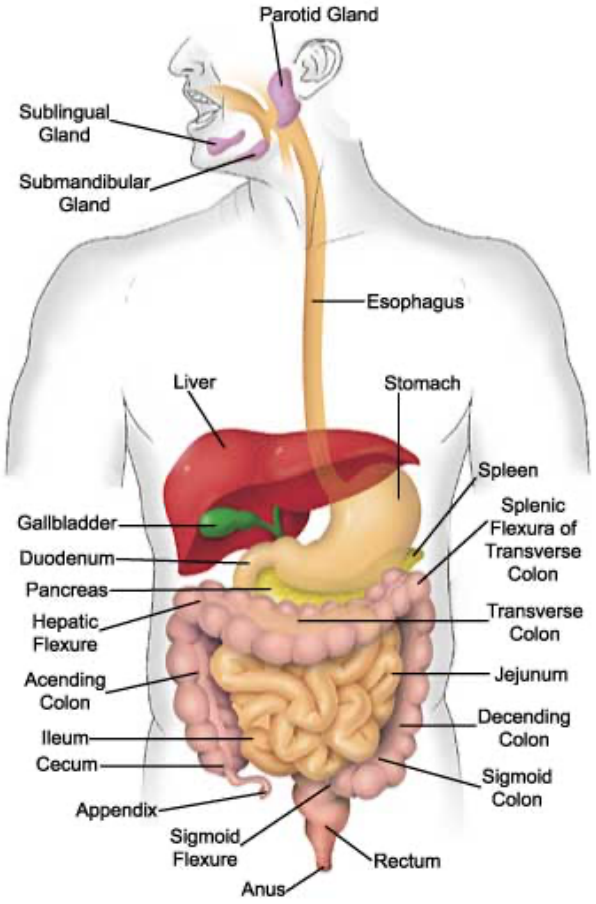
- **Accessory digestive organs**: teeth ,tongue ,salivary gland ,liver ,gallbladder ,and pancreas

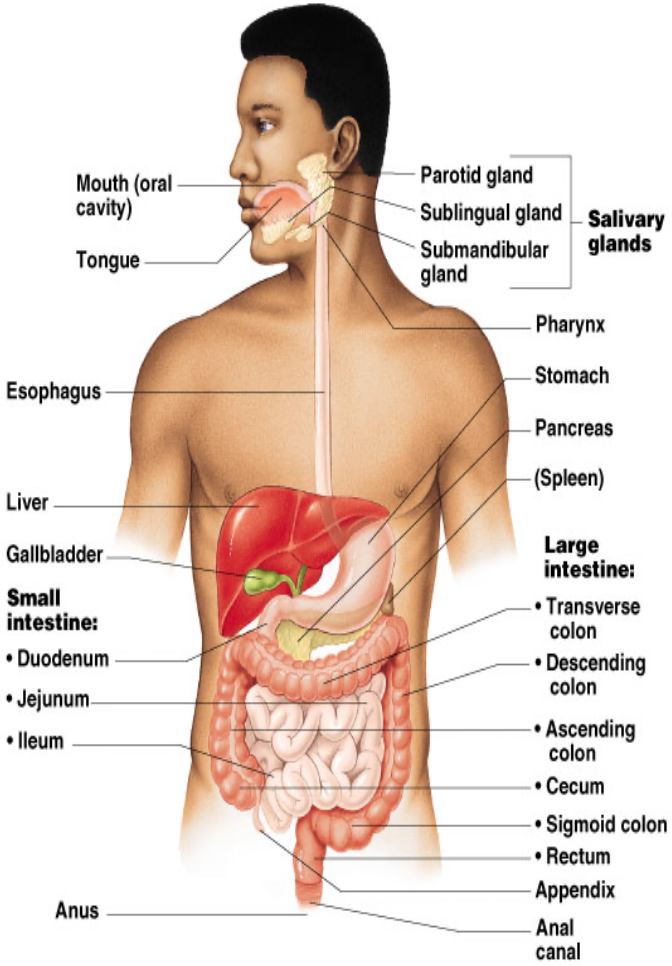
الأعضاء الهضمية الملحقة: الأسنان واللسان

الغدة اللعابية والكبد والمرارة و

بنكرياس

Organs of the Digestive System





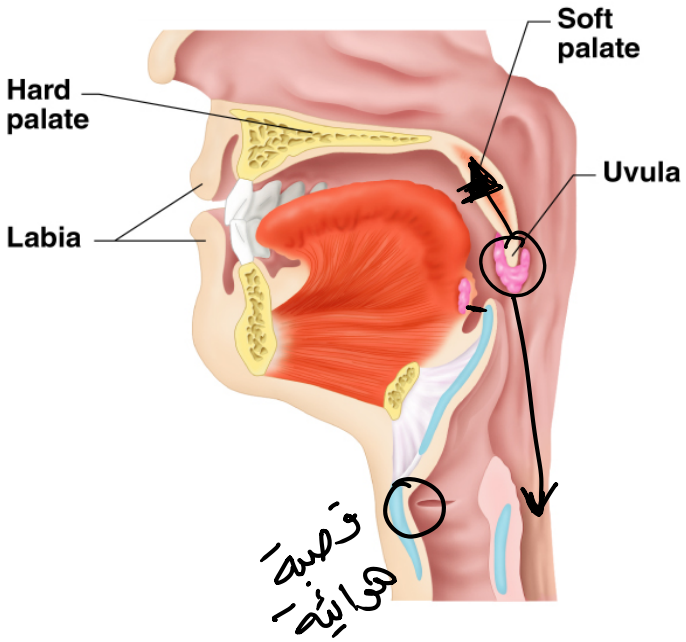
Organs of the Alimentary Canal

بالترتيب

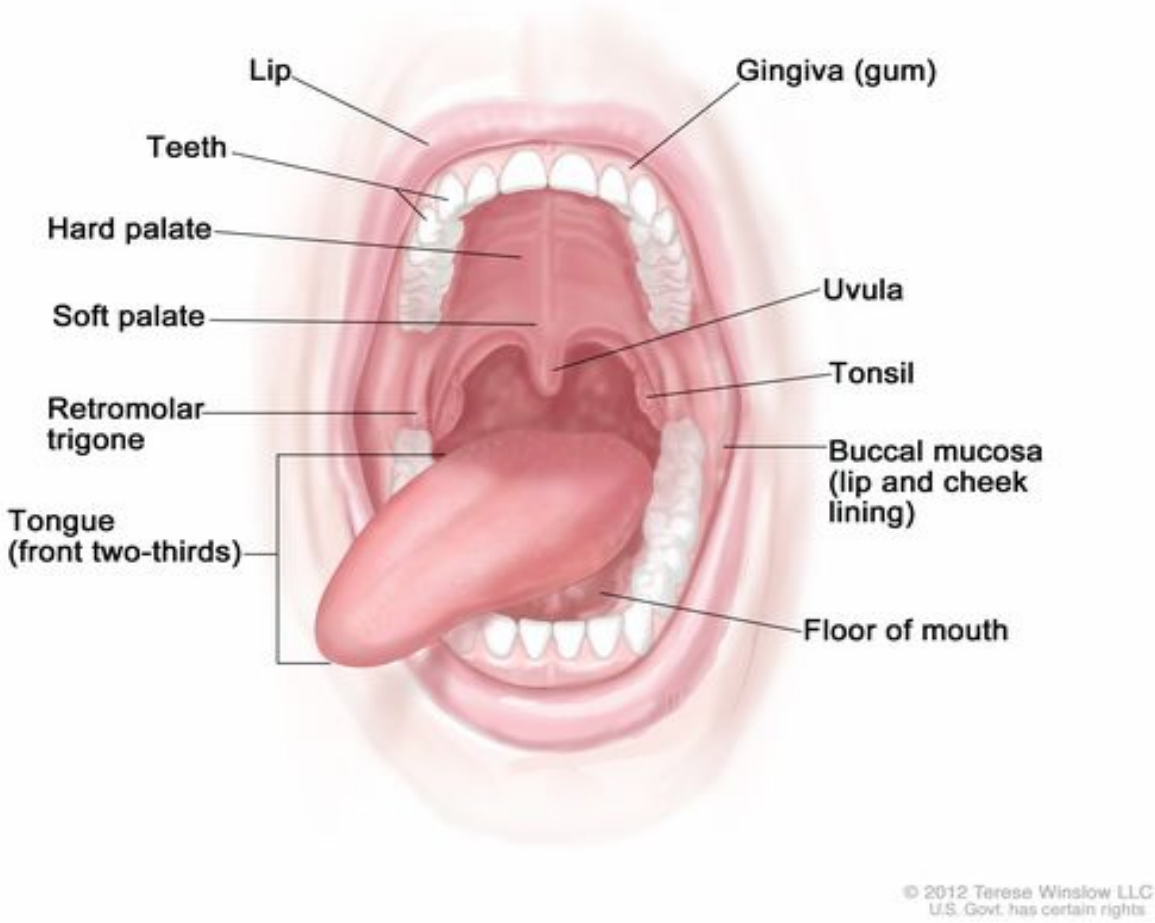
1. Mouth
2. Pharynx → بلعوم
3. Esophagus → مريء
4. Stomach → معدة
5. Small intestine امعاء دقيقة
6. Large intestine // غليظة
7. Anus → فتحة الشرج

Mouth (Oral Cavity) Anatomy

- **Lips** (labia) – protect the anterior opening
- **Cheeks** – form the lateral walls
- **Hard palate** – forms the anterior roof
- **Soft palate** – forms the posterior roof
- **Uvula** – fleshy projection of the soft palate

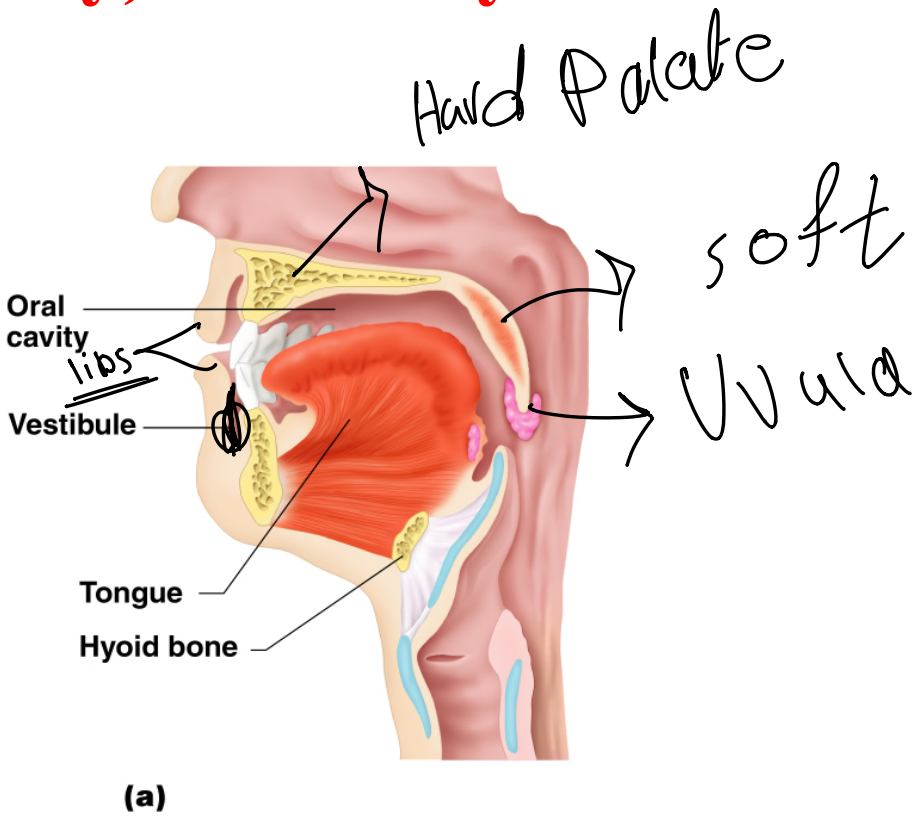


Anatomy of the Oral Cavity



Mouth (Oral Cavity) Anatomy

- **Vestibule** – space between lips externally and teeth and gums internally
- **Oral cavity**
- **Tongue**

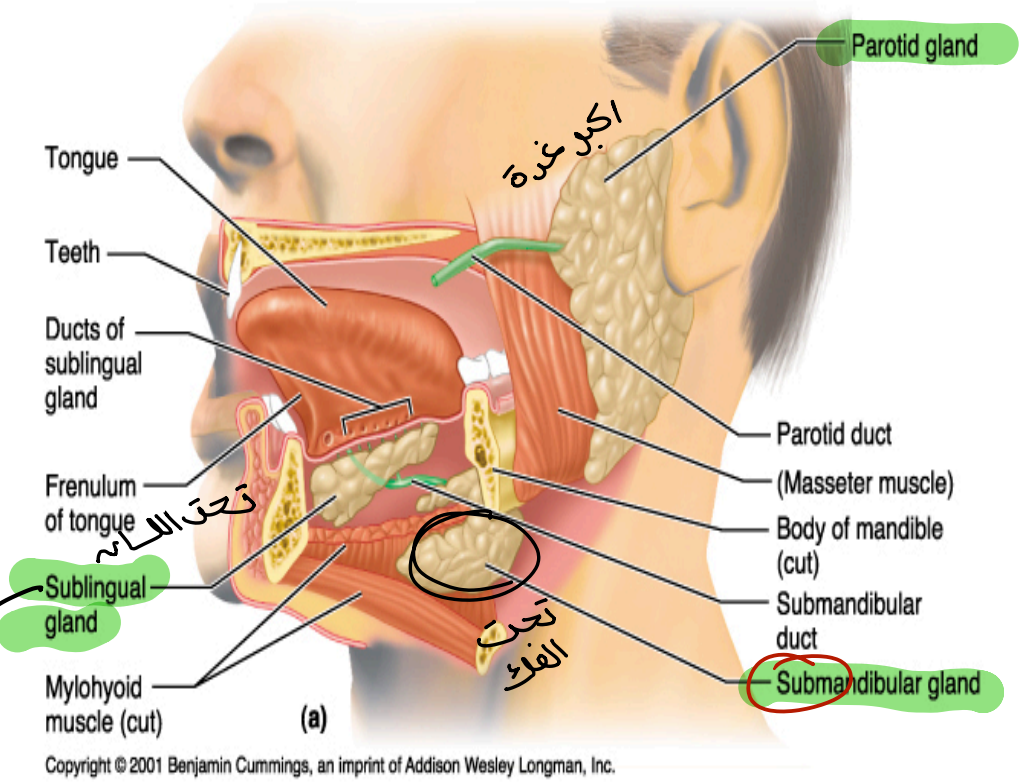


Salivary glands

1. Parotid gland:

2. Submandibular gland

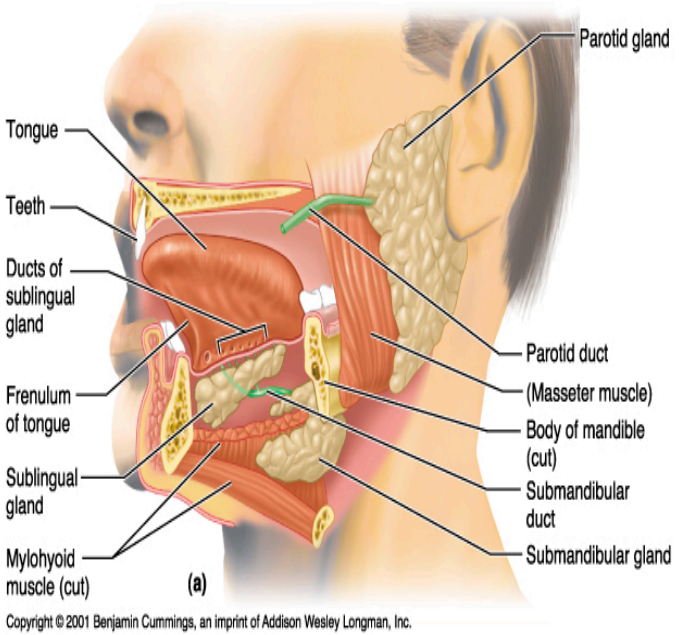
3. Sublingual gland



لعاب

Saliva Function

- Mixture of mucus and serous fluids
- Helps to form a food bolus تكوين اللقمة
- Contains salivary amylase to begin starch digestion
- Dissolves chemicals so they can be tasted



- يحتوي على اللعاب الأميليز لبدء النشا هضم
- يذوب المواد الكيميائية لذلك يمكن تذوقها

Sara Alzeftawi

Processes of the Mouth

- **Mastication** (chewing) of food
- **Mixing** masticated food with saliva to produce easily digested food called a **bolus**
- Saliva contains 2 enzyme
  1. salivary amylase
  2. lingual lipase
- **Initiation of swallowing**

- مضغ (مضغ) الطعام
- خلط الطعام الممضغ مع اللعاب من أجل إنتاج طعام سهل الهضم يسمى بلعة
- يحتوي اللعاب على إنزيمين
  1. الأميليز اللعابي
  2. الليباز اللغوي
- بدء البلع

Layers of Alimentary Canal Organs → organ diagestve

1. Mucosa: غشاء مخاطي

أ. ظهارة السطح:

➢ب. كمية صغيرة من النسيج الضام (الصفيحة الخاصة)

➢ج. طبقة العضلات الملساء الصغيرة

➢**A. Surface epithelium**:

➢**B. A small amount of connective tissue (lamina propria)**

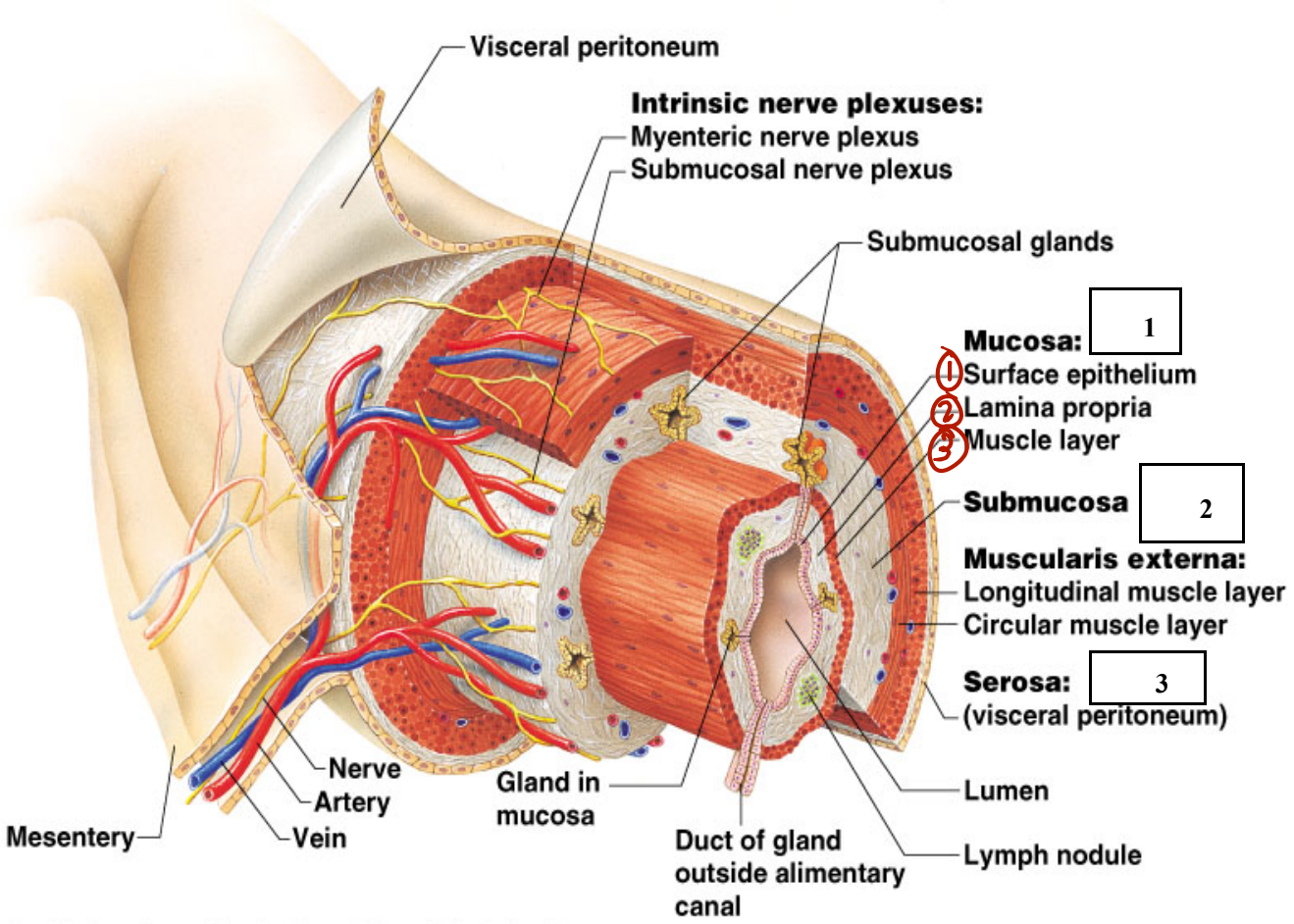
➢**C. The small smooth muscle layer**

2. Submucosa → تحت المخاطية

3. Muscularis externa → عضلة خارجية

4. Serosa مصلي

Layers of Alimentary Canal Organs

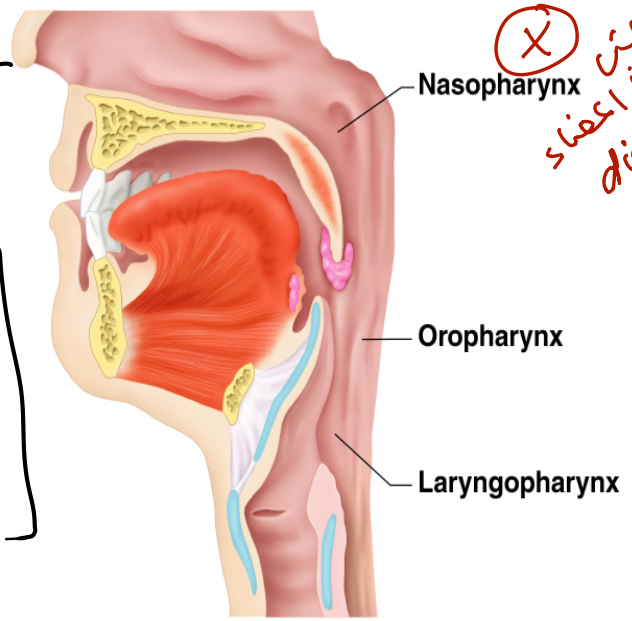


Pharynx Anatomy

1. **Nasopharynx** – **not** part of the digestive system

2. **Oropharynx** – posterior to the oral cavity

3. **Laryngopharynx** – below the oropharynx and connected to the esophagus



(a)

Esophagus

يقع المريء خلف الحنجرة والقصبة الهوائية في الرقبة المنطقة والصدر العلوي.

- **The esophagus** is posterior to the larynx and trachea in the neck region and upper thorax.

يمر عبر الحجاب الحاجز ويتصل بالمعدة (25 سم)

- It passes through the diaphragm and connects with the stomach (25 cm)

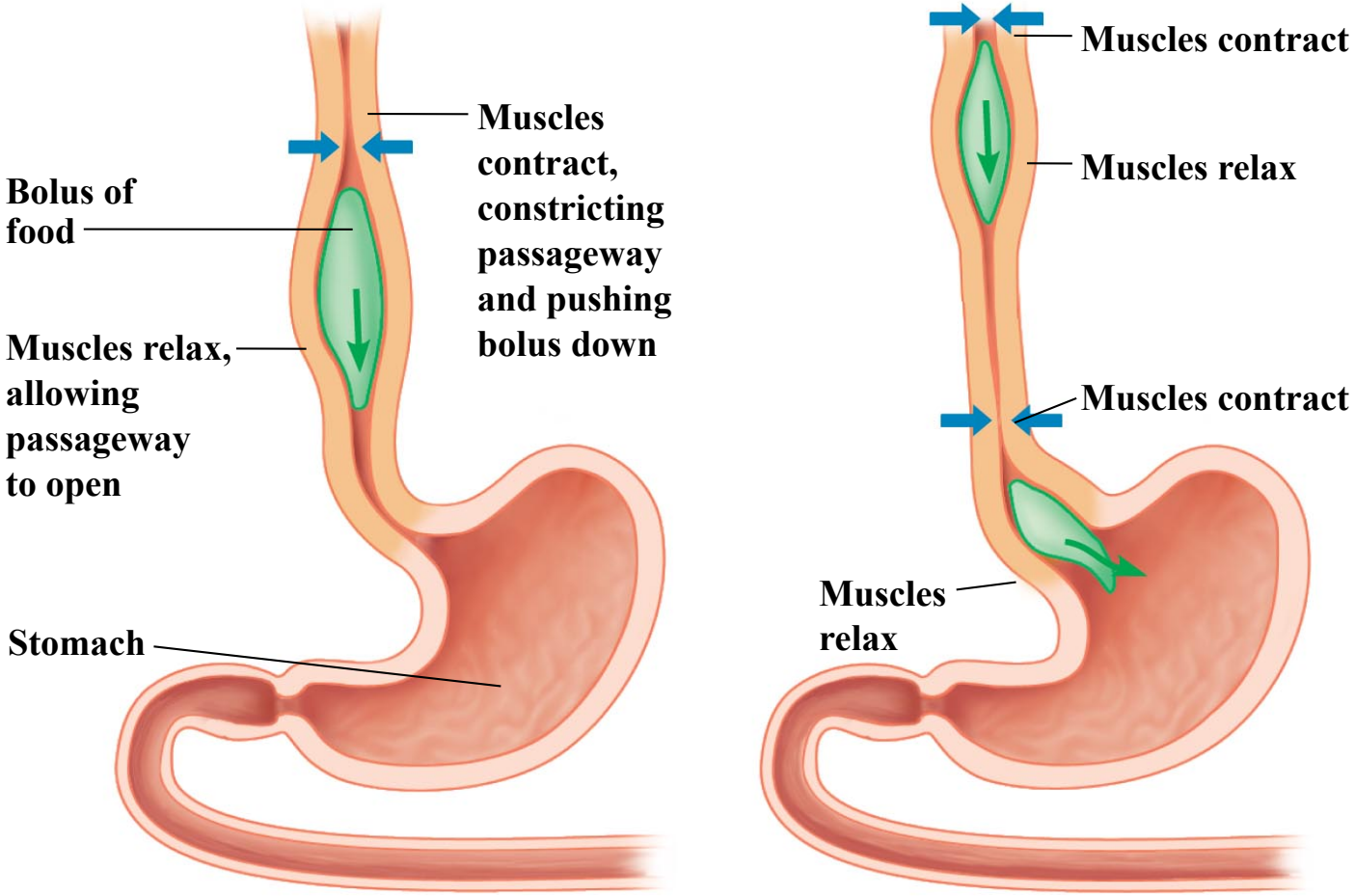
يقوم بتوصيل الطعام عن طريق التمعج الضغط الإيقاعي البطيء

- Conducts food by **peristalsis** (slow rhythmic squeezing)
- **Peristalsis:** contraction of the circular layer above the food and contraction of longitudinal below the food

- The **upper third** is skeletal muscle (voluntary), the **middle third** is mixed, and the **lower third** is smooth muscle (involuntary)

الحركة الدودية

Peristalsis in Esophagus



Stomach Anatomy

- Located on the left side of the abdominal cavity

- The stomach is a **J-shaped** enlargement of the GI tract directly inferior to the diaphragm in the abdomen.

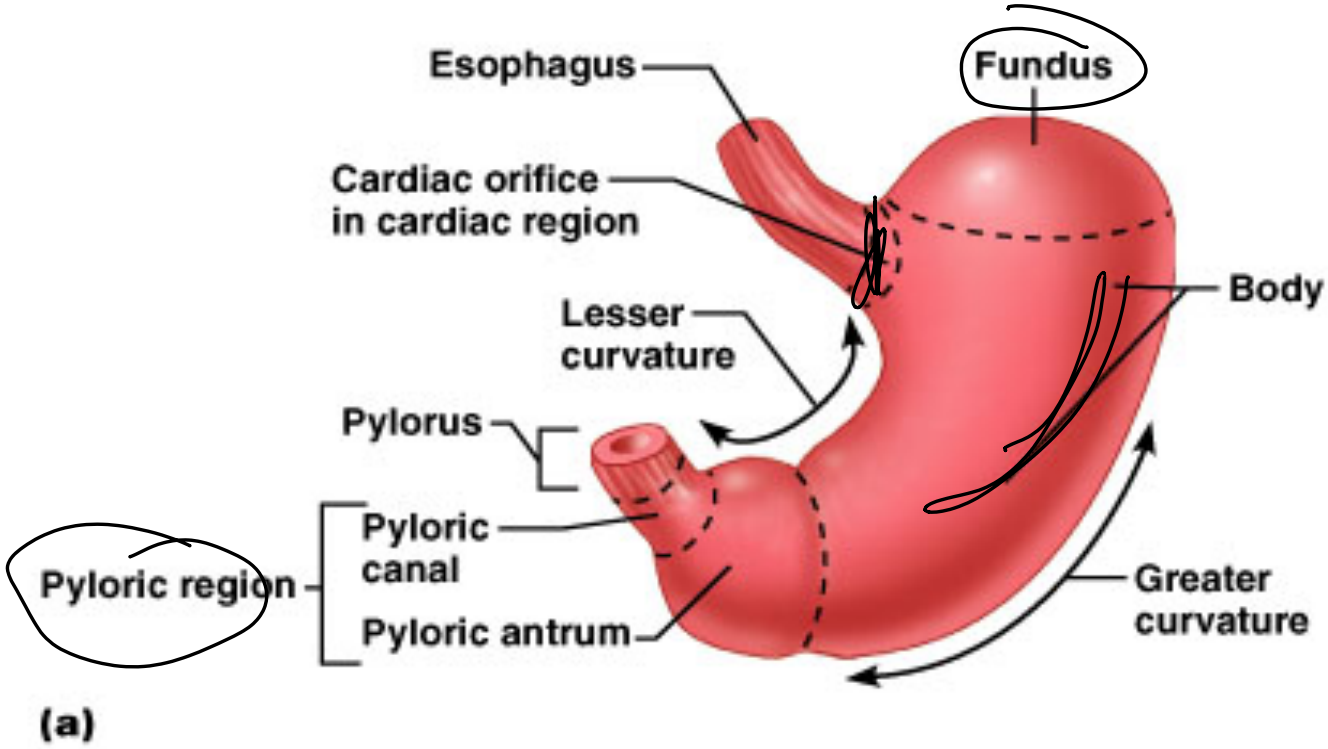
- The stomach connects the esophagus to the duodenum

Stomach Anatomy

Regions of the stomach:

1. **Cardiac region**
2. **Fundus**
3. **Body**
4. **Pylorus**
5. Food empties into the small intestine at the **pyloric sphincter**

Stomach

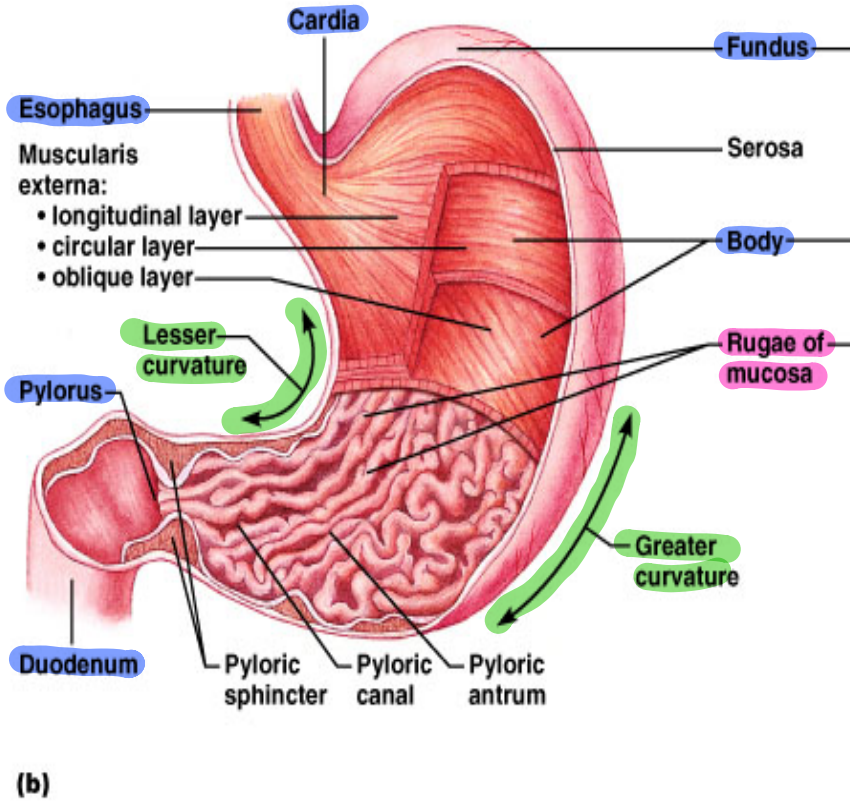

Esophagus
Fundus
Cardiac orifice
in cardiac region
Body
Lesser
curvature
Pylorus
Pyloric
canal
Pyloric region
Pyloric antrum
Greater
curvature
(a)

Stomach Anatomy

- **Rugae**: internal folds of the mucosa

طيات من الغشاء المخاطي

- **External regions**
  - Lesser curvature
  - Greater curvature



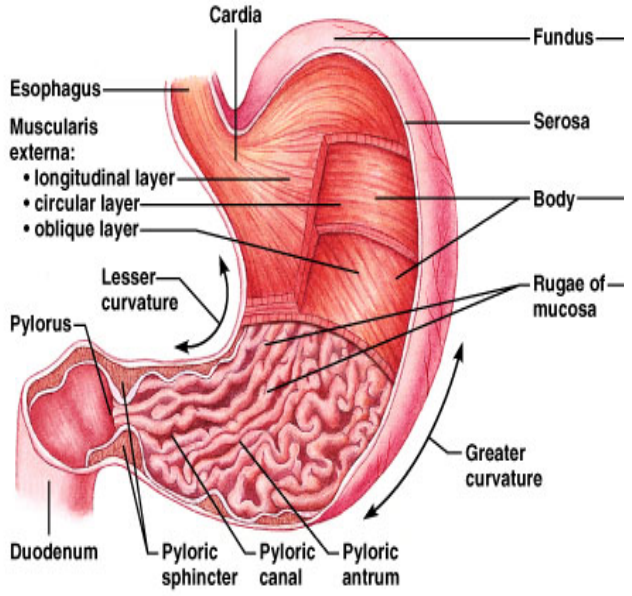
Stomach Functions

. Acts as a storage tank for food

I. Site of food breakdown and mixing

II. Chemical breakdown of protein begins

V. Delivers chyme (processed food) to the small intestine



(b)

Specialized Mucosa of the Stomach

- **Simple columnar epithelium**
- **Mucous neck cells:** produce a sticky alkaline mucus
- **Gastric glands:** secrete gastric juice (عصارة المعدة)
- **Chief cells:** produce digesting enzymes (pepsinogens)
- **The Acid** in the stomach changes pepsinogen to pepsin, which breaks down proteins in food during digestion

- ظهارة عمودية بسيطة
- خلايا الرقبة المخاطية: تنتج مخاطا قلويا لزجا
- غدد المعدة: تفرز عصير المعدة
- الخلايا الرئيسية: تنتج إنزيمات الهضم (البيبسينوجينات)
- الحمض في المعدة يغير البيبسينوجين إلى البيبسين،

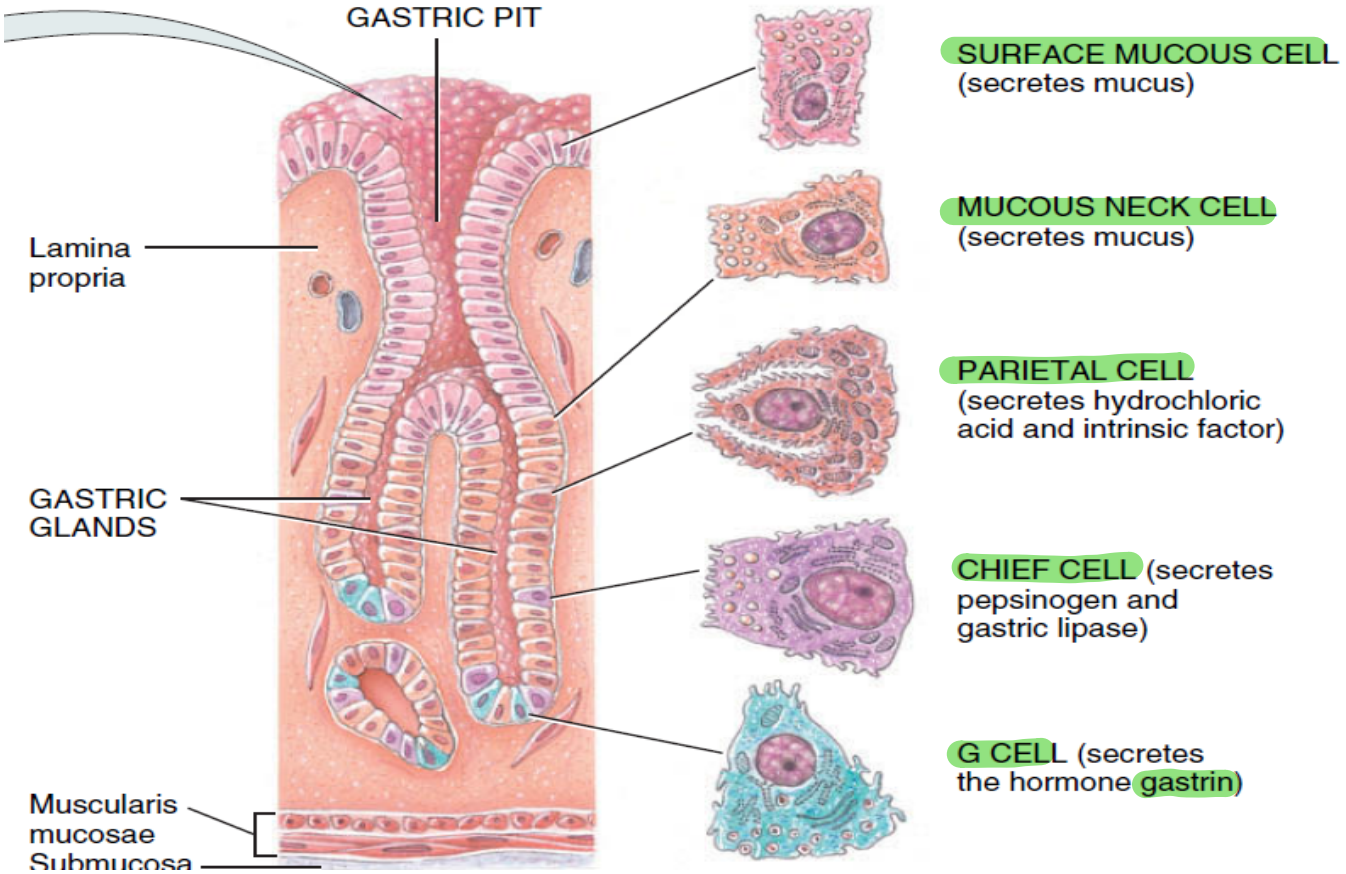
الذي يكسر البروتينات في الطعام أثناء الهضم

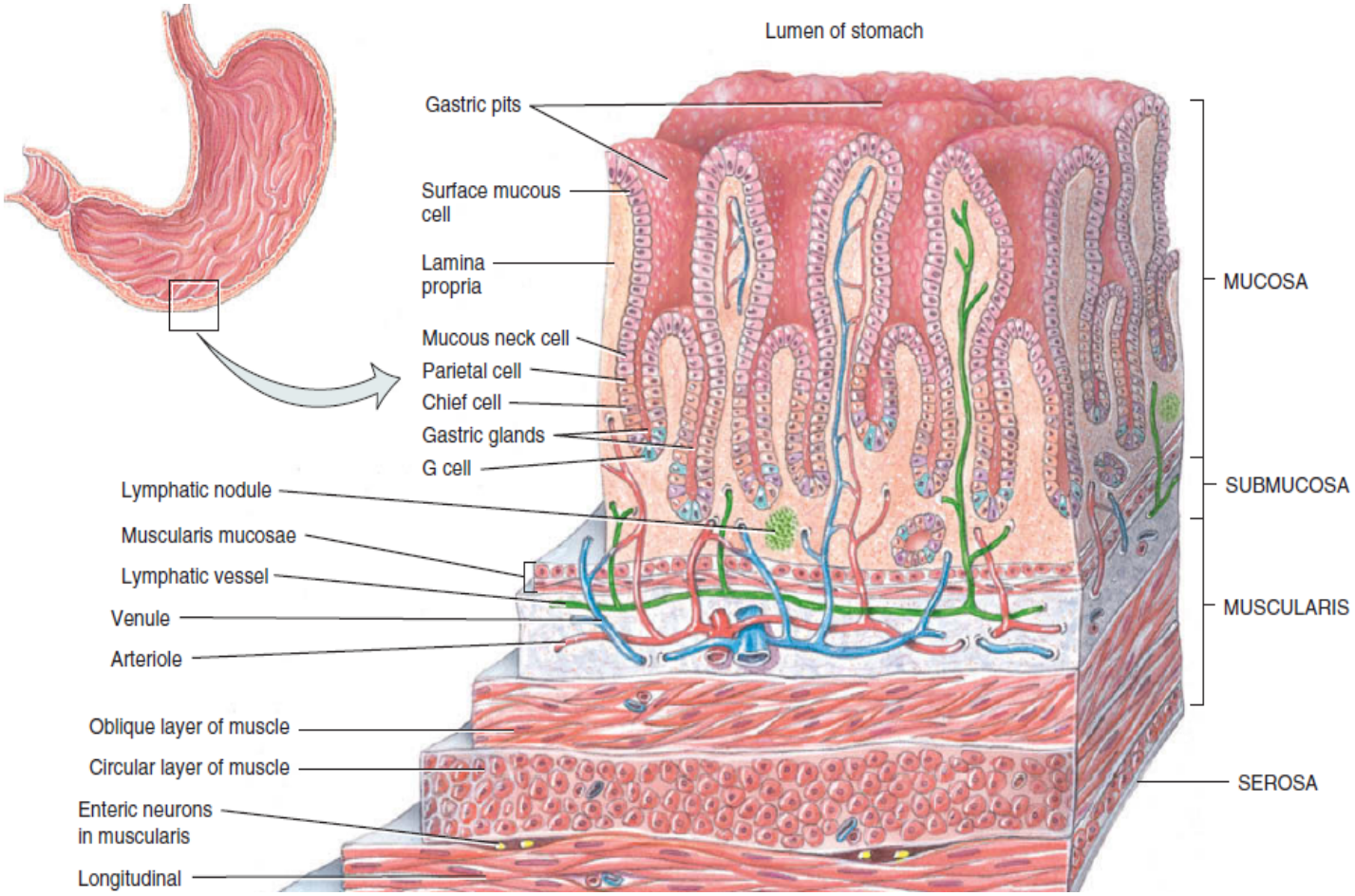
Specialized Mucosa of the Stomach

- **Parietal cells:** produce hydrochloric acid (HCL) and Intrinsic factor for B12 absorption
- The hydrochloric acid in the gastric juice **breaks down the food** and the digestive enzymes split up the proteins. The acidic gastric juice also **kills bacteria**

- **Endocrine cells** (G cell): produce **gastrin** which stimulates **both parietal and chief cells**

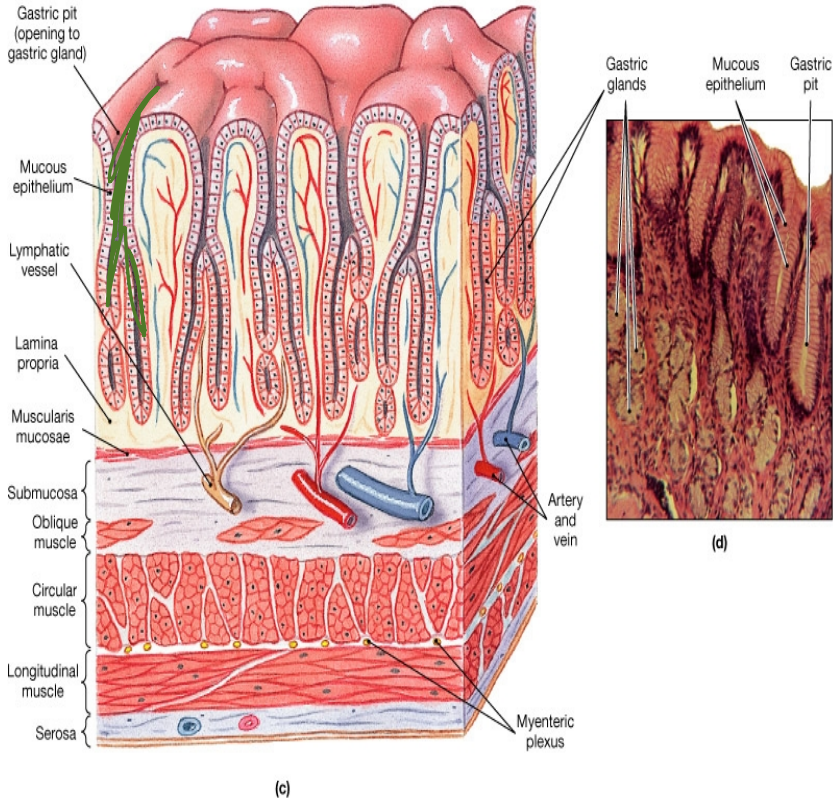
Structure of the Stomach Mucosa




Lumen of stomach
Gastric pits
Surface mucous cell
Lamina propria
Mucous neck cell
Parietal cell
Chief cell
Gastric glands
G cell
Lymphatic nodule
Muscularis mucosae
Lymphatic vessel
Venule
Arteriole
Oblique layer of muscle
Circular layer of muscle
Enteric neurons in muscularis
Longitudinal
MUCOSA
SUBMUCOSA
MUSCULARIS
SEROSA

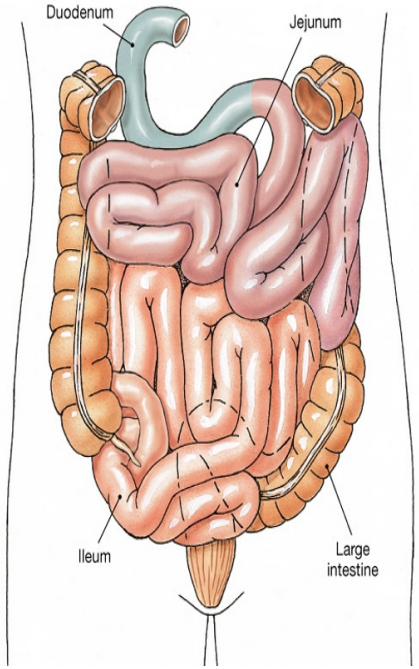
Structure of the Stomach Mucosa

- **Gastric pits** formed by folded mucosa
- Glands and specialized cells are in the gastric gland region



Small Intestine

- The body's major digestive organ
- Site of nutrient absorption into the blood
- Muscular tube extending from the pyloric sphincter to the ileocecal valve
- Suspended from the posterior abdominal wall by the mesentery



أنبوب عضلي يمتد من

العضلة العاصرة البوابية إلى

الصمام اللفائفي القاسي

معلق من الخلف

جدار البطن بواسطة المساريق

Functions Of The Small Intestine

تخلط التجزئات الكيم مع العصائر الهضمية و

جعل الطعام على اتصال بالغشاء المخاطي للامتصاص؛

يدفع التمعج الكيم عبر الأمعاء الدقيقة.

1. Segmentations **mix chyme with digestive juices** and bring food into contact with mucosa for absorption; peristalsis propels chyme through the small intestine.

2. **Completes digestion** of carbohydrates, proteins, and lipids; begins and completes digestion of nucleic acids.

3. **Absorbs about 90% of nutrients** and water that pass through the digestive system.

Subdivisions of the Small Intestine

1. Duodenum (25cm)

➢Attached to the stomach

➢Curves around the head of the pancreas

➢Fixed retroperitoneal structure

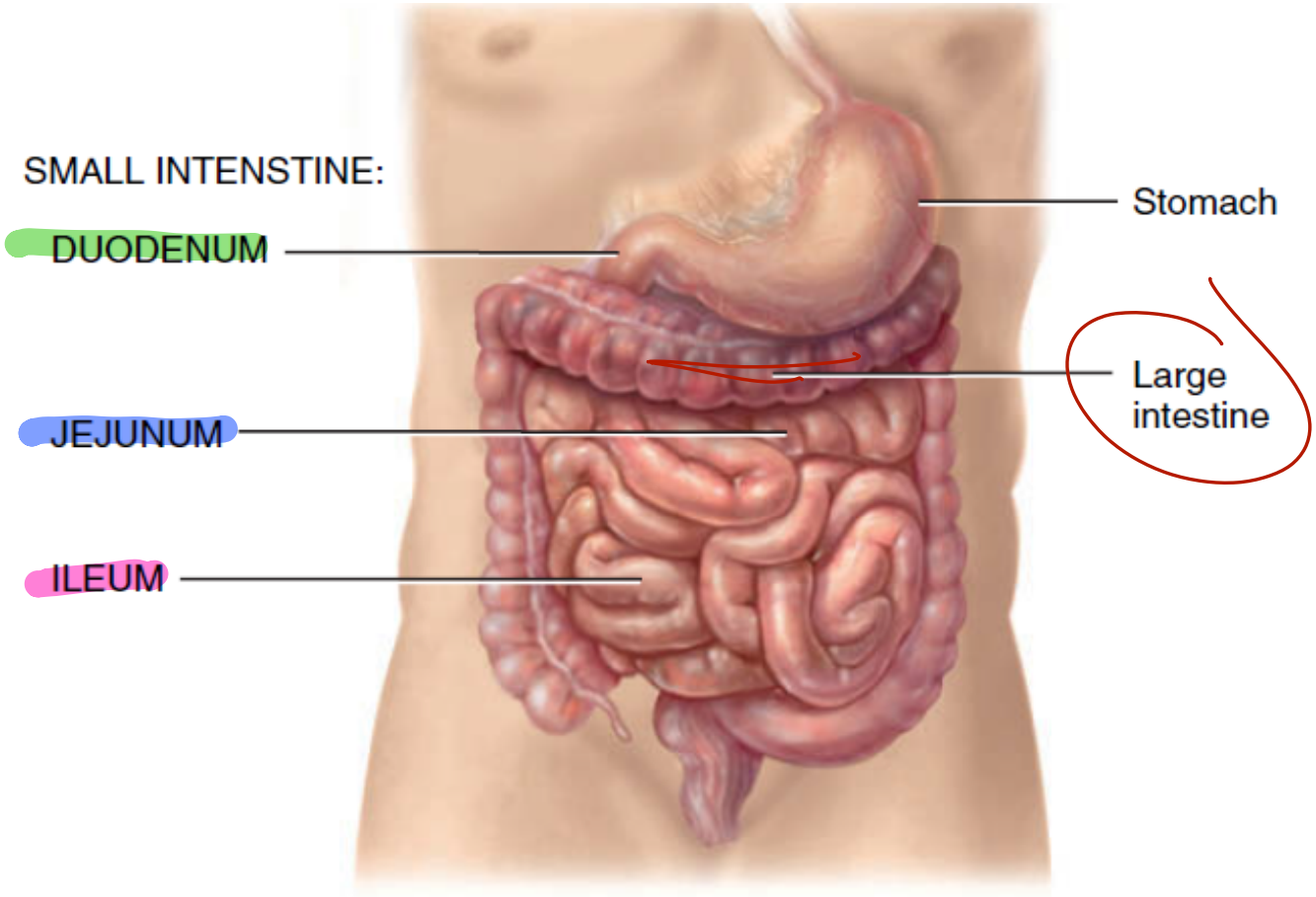
2. Jejunum (2.5m)

➢Attaches anteriorly to the duodenum

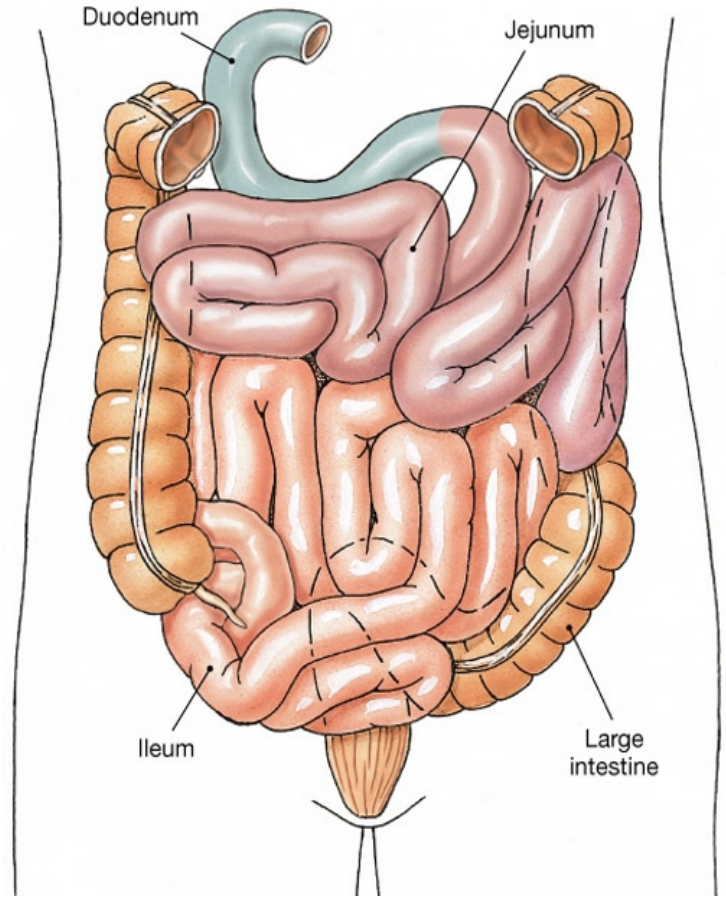
3. Ileum (3.5m)

➢Extends from jejunum to large intestine

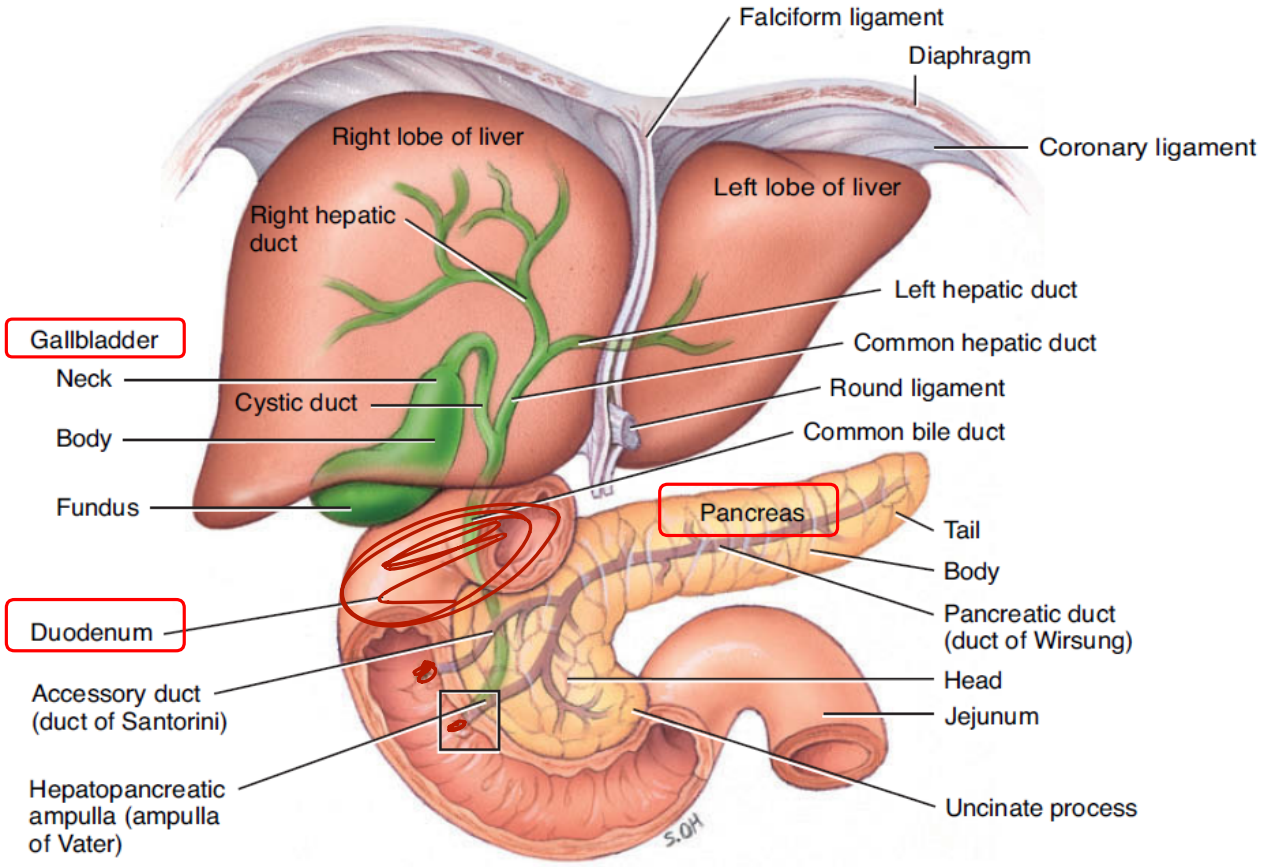
Small Intestine



Small Intestine



Duodenum and Related Organs



(a) Anterior view

Chemical Digestion in the Small Intestine

مصدر الإنزيمات التي يتم خلطها مع

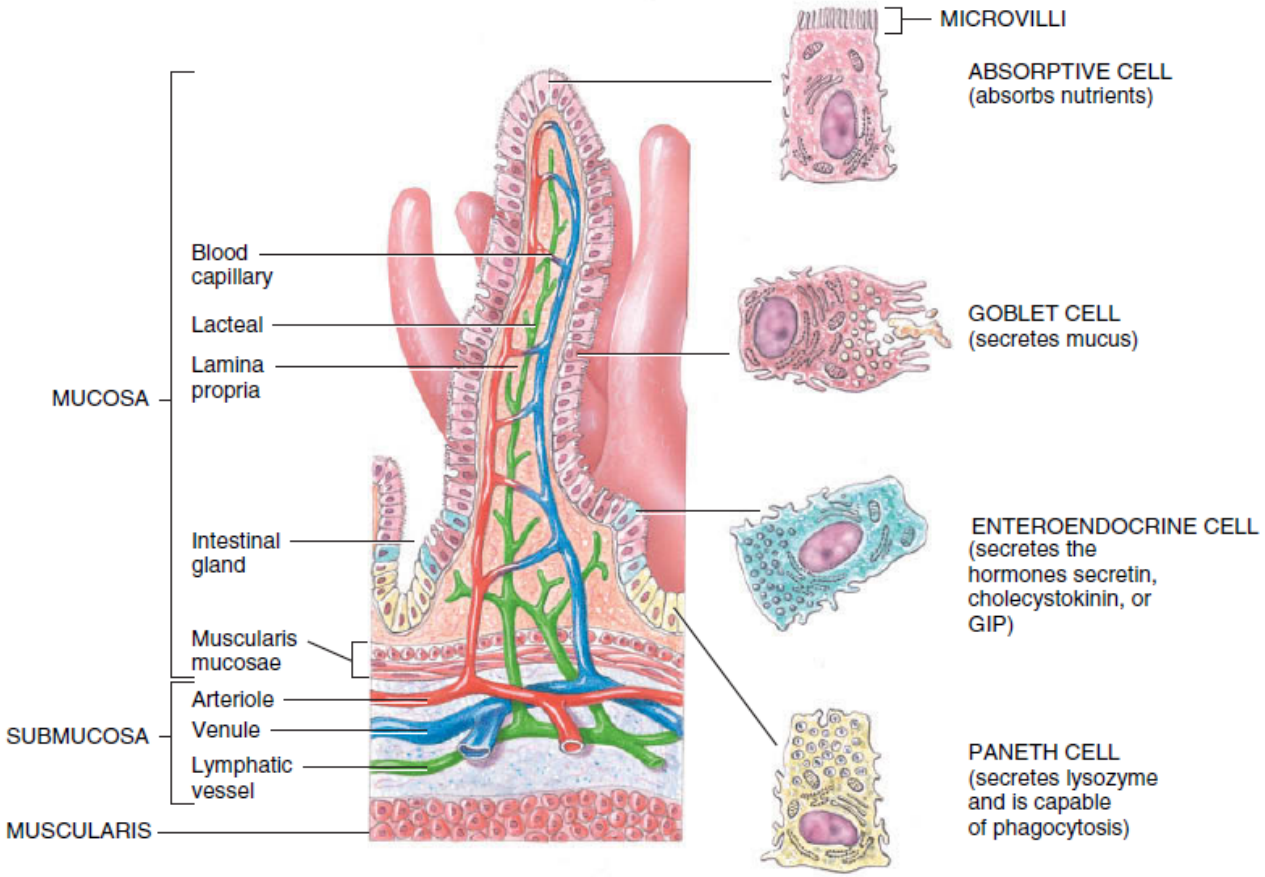
Chyme:

Source of enzymes that are mixed with chyme:

1. Intestinal cells
2. Pancreas
3. Bile enters from the gallbladder

عصارة صفراء المرارة

Intestinal cells



تتكون الطبقة الظهارية للغشاء المخاطي للأمعاء الدقيقة من

ظهارة عمودية بسيطة تحتوي على الكثير

Intestinal cells

- The epithelial layer of the small intestinal mucosa consists of simple columnar epithelium that contains many

الخلايا الامتصاصية: تطلق الإنزيمات التي تهضم الطعام و

تحتوي على الزغابات الدقيقة التي تمتص العناصر الغذائية في الأمعاء الدقيقة

Chyme.

Types of Cells

1. **Absorptive cells**: release enzymes that digest food and contain microvilli that absorb nutrients in small intestinal chyme.
2. **goblet cells**, which secrete mucus.
3. **intestinal glands** also contain paneth cells and enteroendocrine cells.
4. **Paneth cells** secrete **lysozyme**, a **bactericidal enzyme**, are capable of phagocytosis, and have a role in regulating the microbial and population in the small intestine.

إنزيم مبيد للجراثيم

إفراز الليزوزيم، وهو إنزيم مبيد للجراثيم، هو

قادر على البلعمة، وله دور في تنظيم

الميكروبات والسكان في الأمعاء الدقيقة.

Intestinal cells

Hormones of Enteroendocrine Cells

1. **cholecystokinin (CCK):** hormones that stimulate the contraction of the gallbladder and pancreatic juices

يحفز إفراز البيكربونات، والذي

2. **secretin**: stimulates bicarbonate secretion, which neutralizes the pH of the gastric chyme upon entering the small intestine

إفراز البيكربونات

يحيد الرقم الهيدروجيني لكيم المعدة عند الدخول

الأمعاء الدقيقة

3. **glucose-dependent insulinotropic peptide (GIP)**: encourage the release of insulin into the bloodstream to control blood sugar levels

Villi of the Small Intestine

Villi

·Fingerlike structures formed by the mucosa

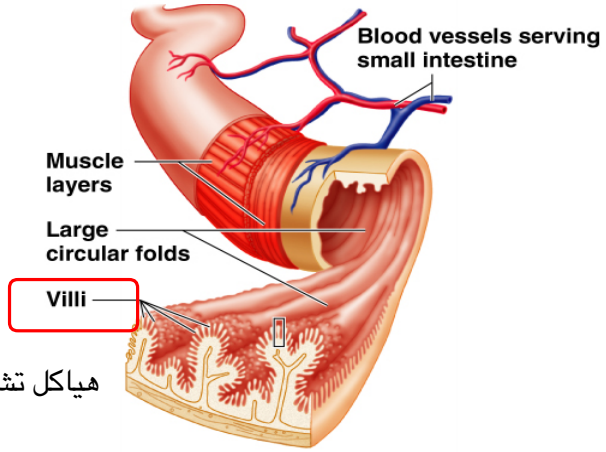
·Give the small intestine more surface area

هياكل تشبه الأصابع

يتكون من الغشاء المخاطي

· أعط الأمعاء الدقيقة

مساحة سطح أكبر



(a) Small intestine

Microvilli

•Small projections of the plasma membrane

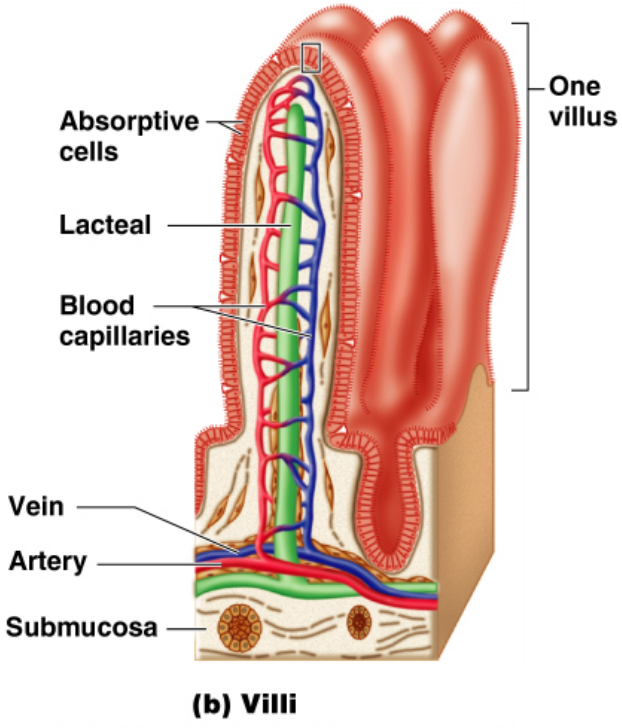
•Found on absorptive cells

(c) Absorptive cells

الهياكل المشاركة في امتصاص العناصر الغذائية

Structures Involved in the Absorption of Nutrients

- Absorptive cells
- Blood capillaries
- Lacteals (specialized lymphatic capillaries)



(b) Villi

Sara

الهضم في الأمعاء الدقيقة

Digestion in the Small Intestine

1. Enzymes from the brush border

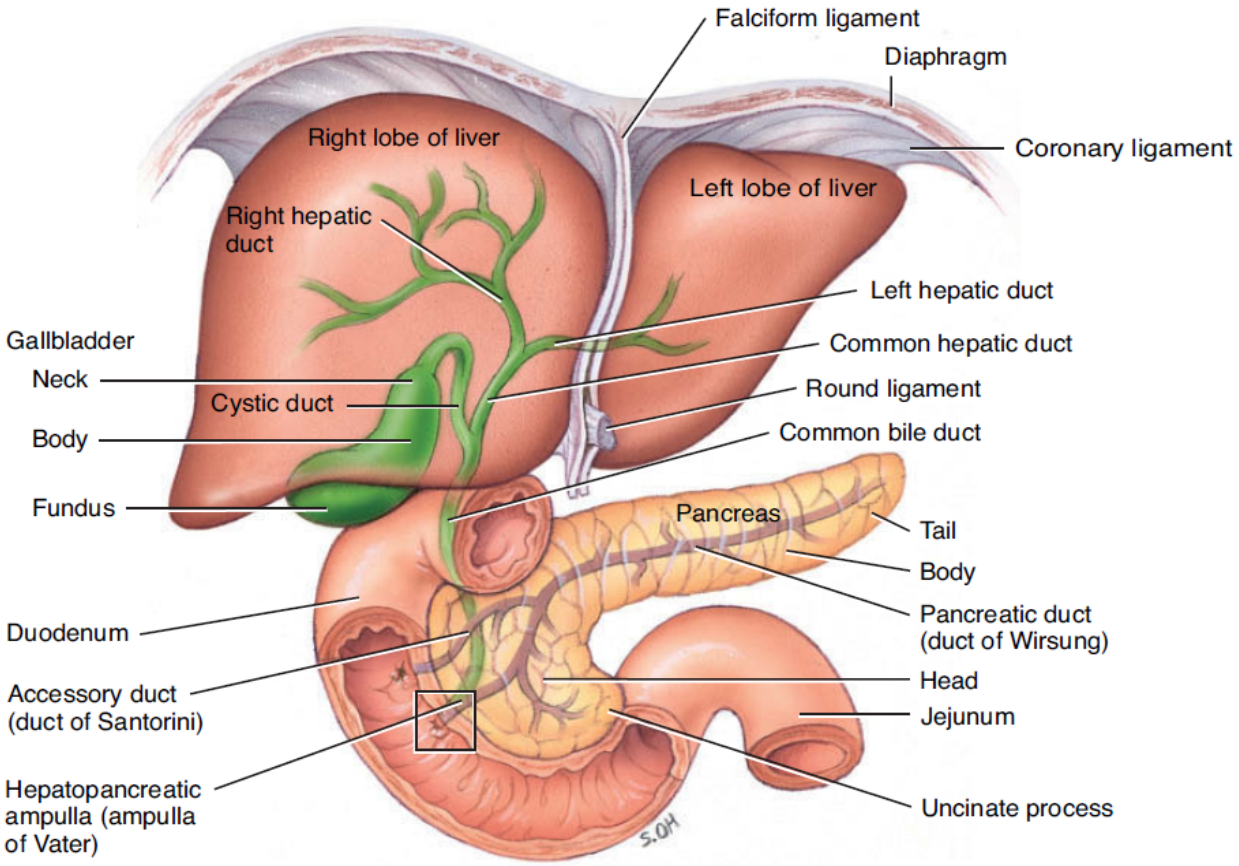
- Break double sugars into simple sugars
- Complete some protein digestion

2. Pancreatic enzymes

- play the major digestive function
- Help complete digestion of starch (**Pancreatic amylase**)
- Carry out about half of all protein digestion (**Trypsin**)
- Responsible for fat digestion (**Lipase**)
- Digest nucleic acids (**Nucleases**)
- Alkaline content neutralizes acidic chyme

- تلعب وظيفة الجهاز الهضمي الرئيسية
- يساعد على الهضم الكامل للنشا (الأميليز البنكرياسي)
- قم بإجراء حوالي نصف جميع عمليات هضم البروتين (التريبسين)
- مسؤول عن هضم الدهون (الليباز)
- هضم الأحماض النووية (Nucleases)
- المحتوى القلوي يحيد الكيم الحمضي

Chemical Digestion in the Small Intestine



(a) Anterior view

Absorption in the Small Intestine

- **Water** is absorbed along the length of the small intestine

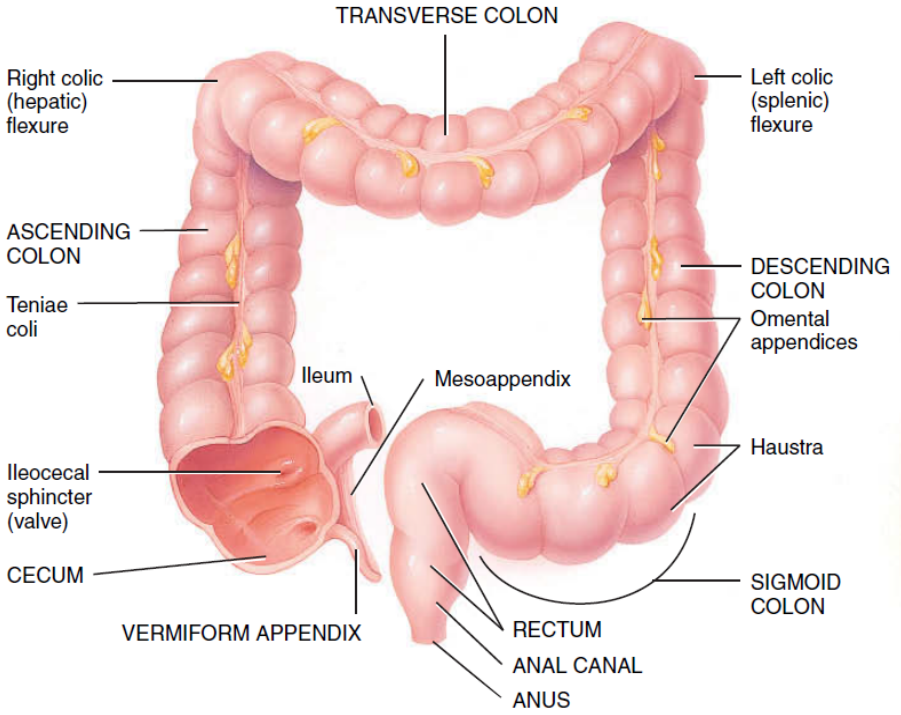
- **End products of digestion**
- Most substances are absorbed by active transport through cell membranes

- **Lipids** are absorbed by diffusion

- **Substances** are transported to the liver by the hepatic portal vein or lymph

Large Intestine

- Larger in diameter but shorter than the small intestine
- Frames the internal abdomen



Regions of Large Intestine

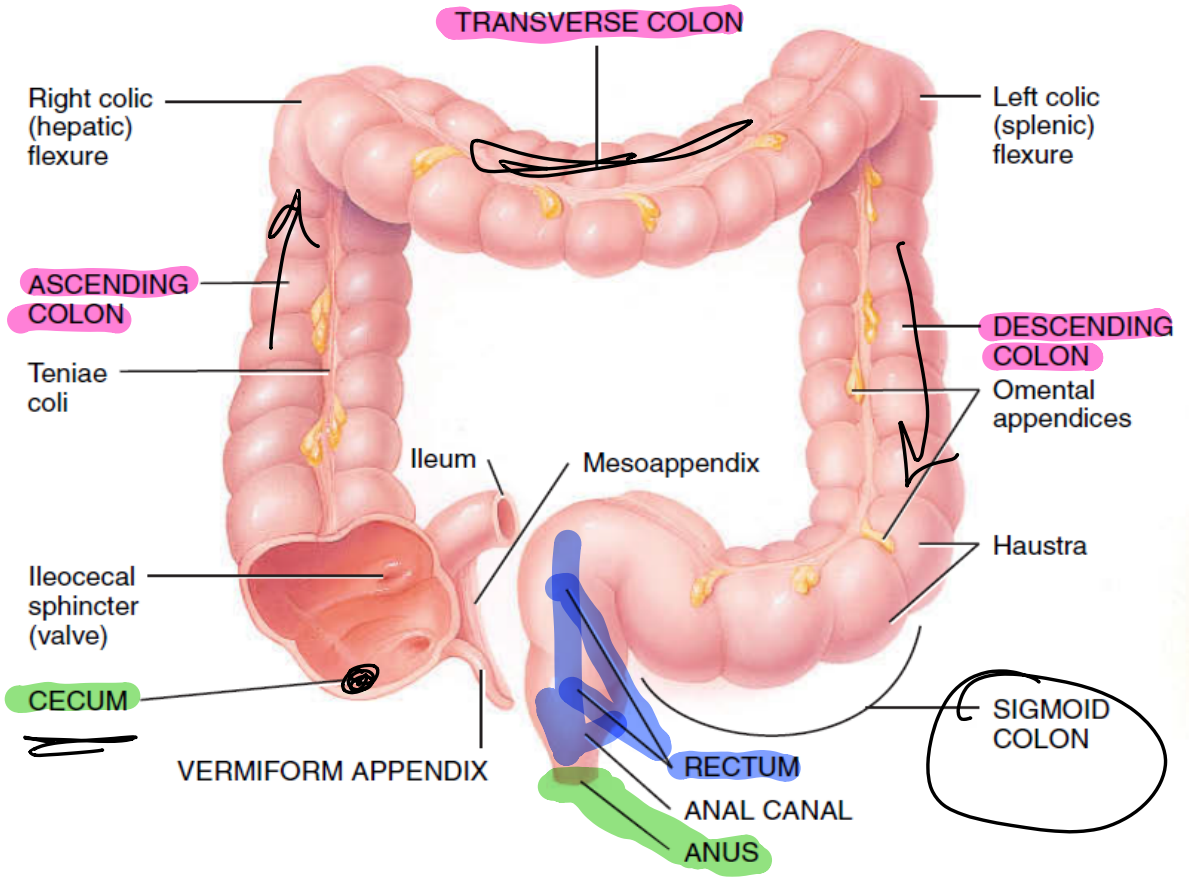
1. **Cecum**: a pocket at the proximal end with an appendix
2. **Ascending colon:** on right, between the cecum and right colic flexure
3. **Transverse colon:** horizontal portion
4. **Descending colon** - left side, between left colic flexure and Sigmoid colon
5. **Rectum**: the terminal end is the anal canal
6. **Anus**: which has

- internal involuntary sphincter
- external voluntary sphincter

العضلة العاصرة اللاإرادية الداخلية

• العضلة العاصرة الطوعية الخارجية

Large Intestine



Histology of Large Intestine

1. Mucosa - abundant goblet cells, stratified squamous epithelium near anal canal

2. No villi

3. Longitudinal muscle layer incomplete, forms three bands or **taenia coli**

4. Circular muscle - forms pockets or **haustra** between bands

Functions of the Large Intestine

1. **Haustral** churning, peristalsis, and mass peristalsis drive the contents of the colon into the rectum

2. **Bacteria** in the large intestine convert proteins to amino acids, produce some B vitamins and vitamin K

3. **Absorption** of some water, ions, and vitamins.

4. **Formation of feces**.

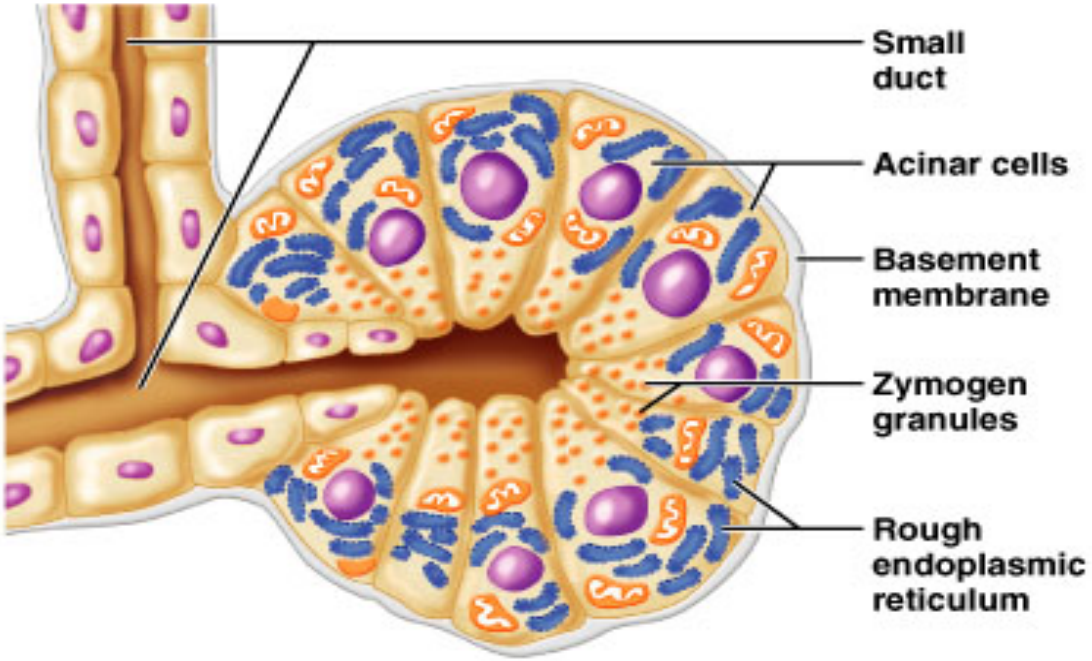
5. **Defecation** (emptying the rectum).
- Internal anal sphincter is relaxed
- Defecation occurs with relaxation of the voluntary (external) anal sphincter

Pancreas

- Produces a wide spectrum of digestive enzymes that break down all categories of food
- Enzymes are secreted into the duodenum
- Alkaline fluid introduced with enzymes neutralizes acidic chyme
- Endocrine products of pancreas (Langerhans island)

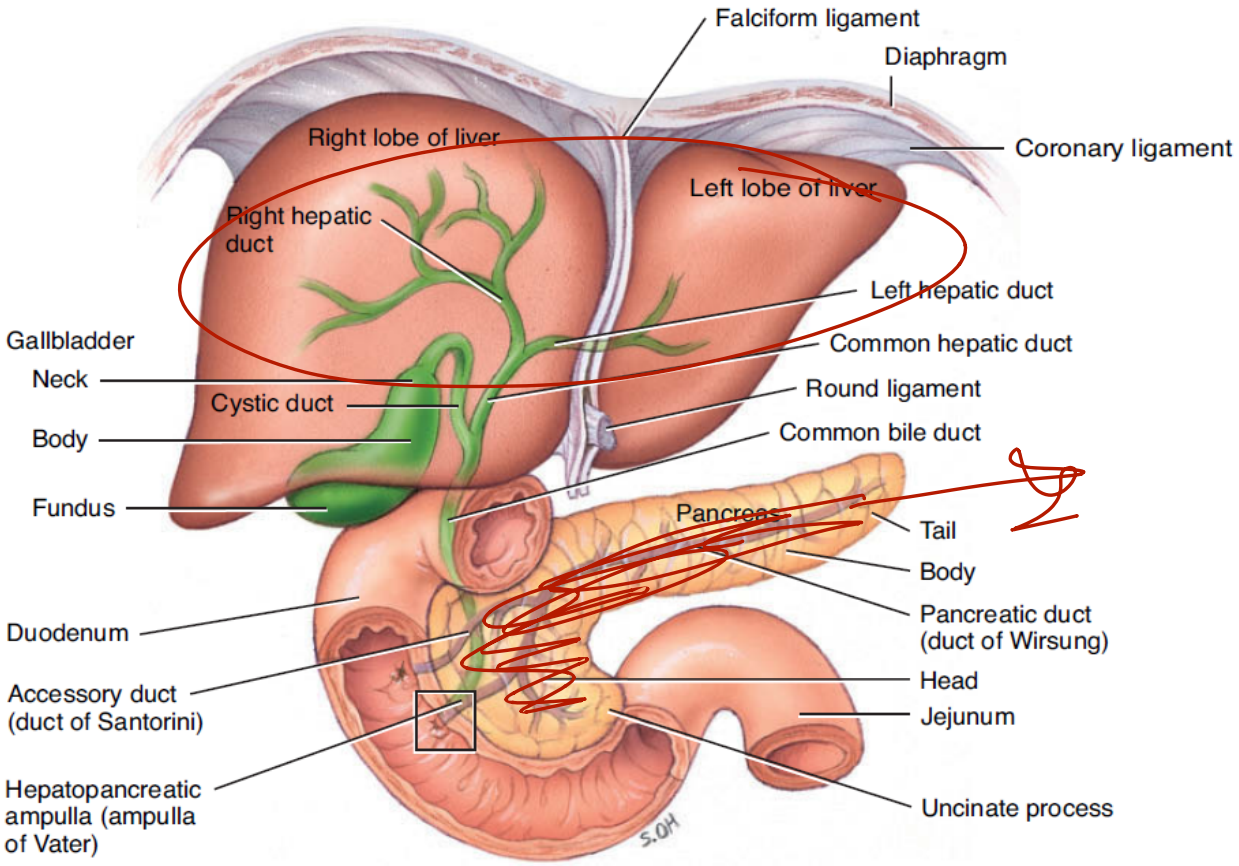
1. Insulin → يخفض سكر الدم
2. Glucagon → يرفع سكر الدم
3. Somatostatin → ينظم افراز 2و1

Exocrine Pancreas: Histology



(a)

Pancreas



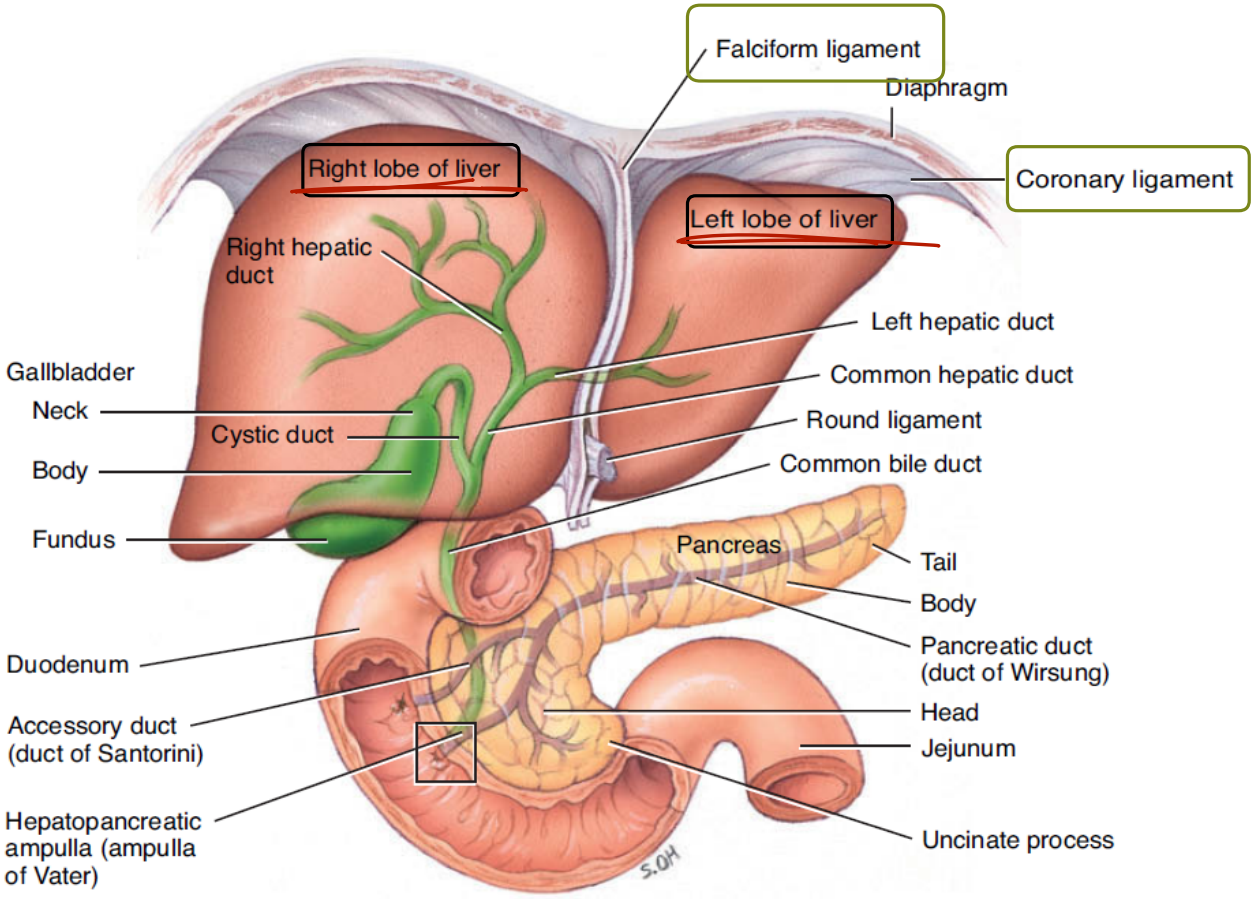
(a) Anterior view

Liver

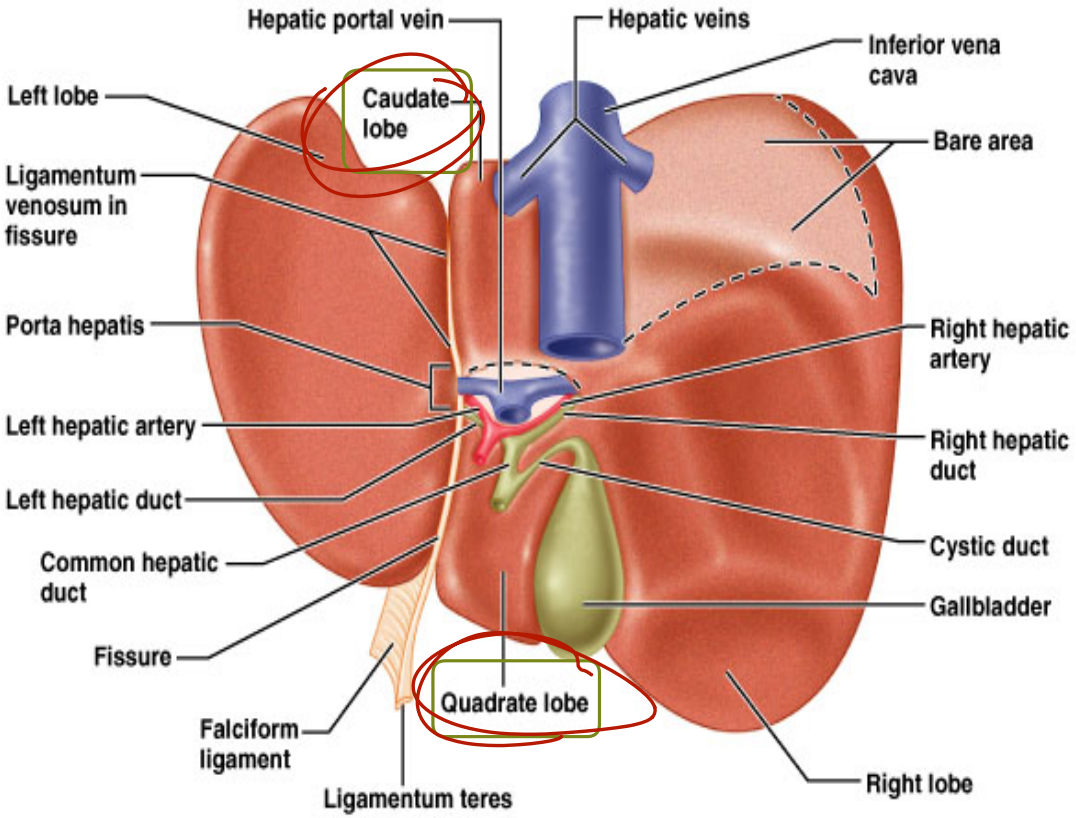
- Largest **gland** in the body
- Located on the **right side** of the body under the diaphragm
- The liver is almost completely covered by the visceral peritoneum

The liver is divided into:

1. Large **Right lobe**
2. Small **Left lobe**
3. Inferior **Quadrate lobe**
4. Posterior **Caudate lobe**



(a) Anterior view


Hepatic portal vein
Hepatic veins
Inferior vena cava
Left lobe
Caudate lobe
Bare area
Ligamentum venosum in fissure
Porta hepatis
Right hepatic artery
Left hepatic artery
Right hepatic duct
Left hepatic duct
Cystic duct
Common hepatic duct
Gallbladder
Fissure
Quadrate lobe
Falciform ligament
Ligamentum teres
Right lobe

Histology of the Liver

1. **Hepatocytes** are the major functional cells of the liver and perform detoxification, carbohydrate metabolism, lipid metabolism, secretion of albumin, and clotting factors

- **Hepatocytes** are specialized epithelial cells that make up about 80% of the volume of the liver.

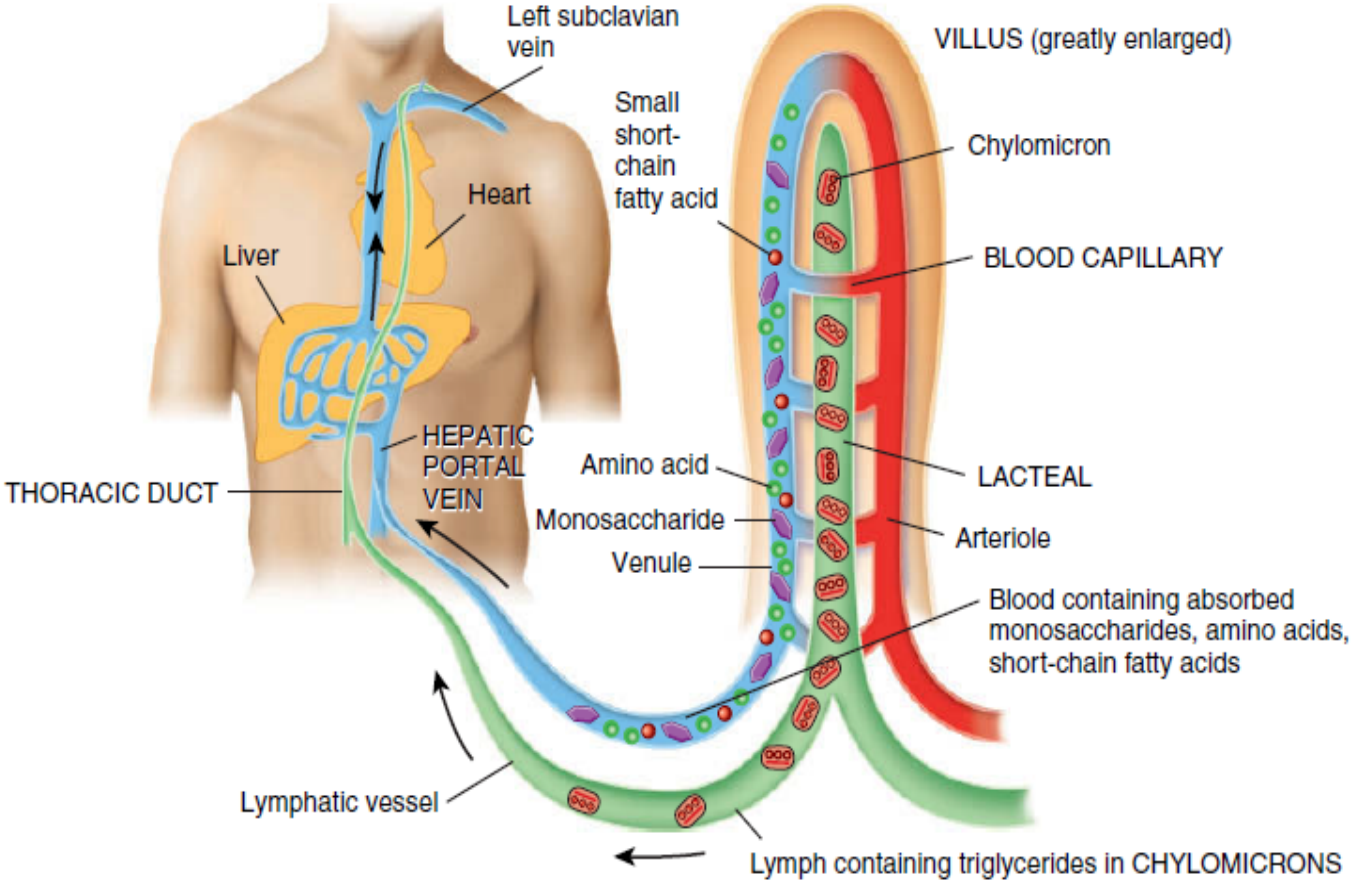
2. **Bile canaliculi** are small ducts between hepatocytes that collect bile produced by the hepatocytes.

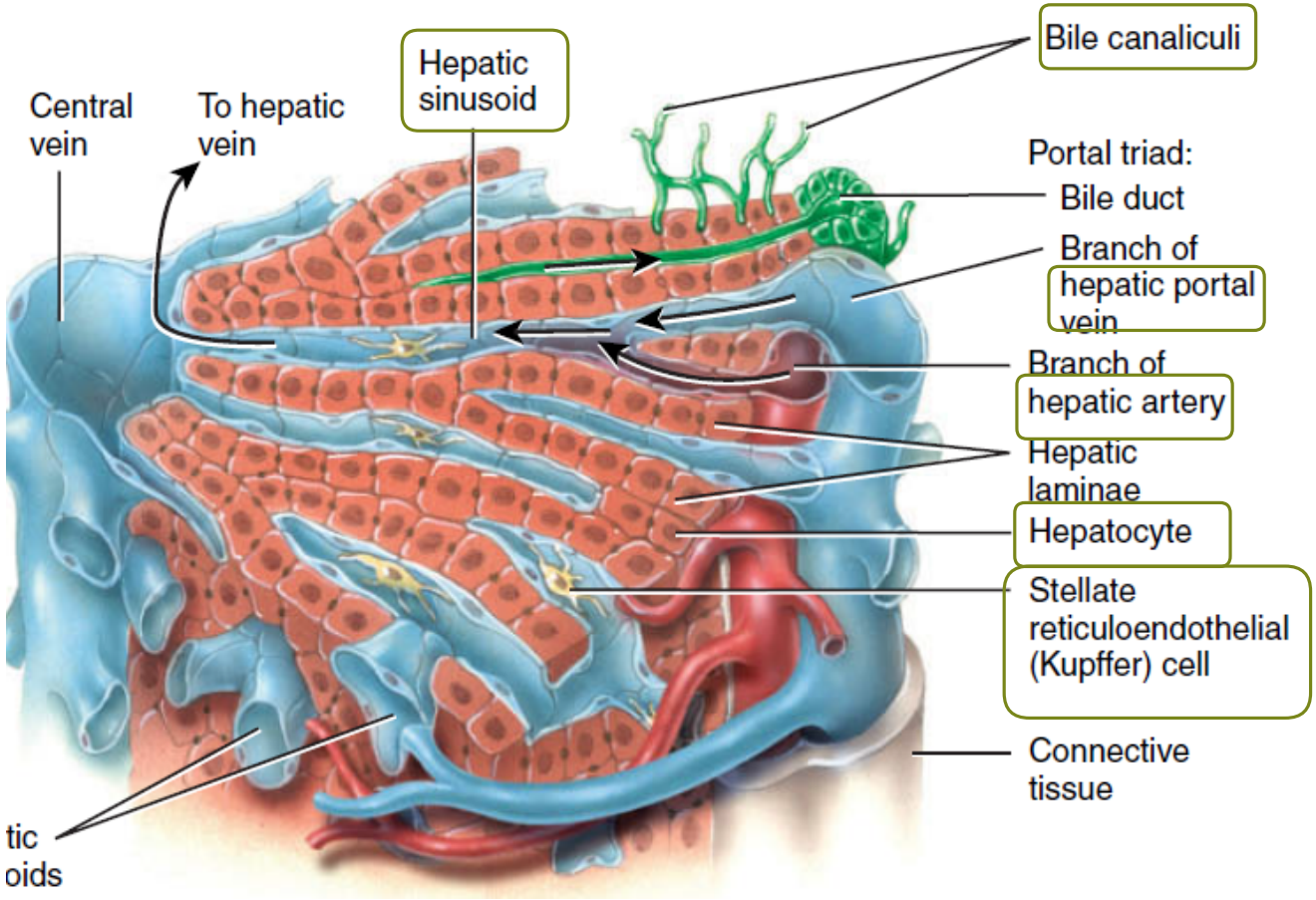
Histology of the Liver

3. Hepatic sinusoids are highly permeable blood capillaries between rows of hepatocytes that receive oxygenated blood from the **hepatic artery** and nutrient-rich deoxygenated blood from the **hepatic portal vein**.

• Present in the hepatic sinusoids are **phagocytes** called stellate reticuloendothelial cells or hepatic macrophages

•**Reticuloendothelial cells**: destroy worn-out white and red blood cells, bacteria, and other foreign matter in the venous blood draining from the gastrointestinal tract


Left subclavian vein
Small short-chain fatty acid
VILLUS (greatly enlarged)
Chylomicron
Heart
Liver
BLOOD CAPILLARY
HEPATIC PORTAL VEIN
THORACIC DUCT
Amino acid
LACTEAL
Monosaccharide
Arteriole
Venule
Blood containing absorbed monosaccharides, amino acids, short-chain fatty acids
Lymphatic vessel
Lymph containing triglycerides in CHYLOMICRONS


Central vein
To hepatic vein
Hepatic sinusoid
Bile canaliculi
Portal triad:
Bile duct
Branch of hepatic portal vein
Branch of hepatic artery
Hepatic laminae
Hepatocyte
Stellate reticuloendothelial (Kupffer) cell
Connective tissue
tic
oids

Role of the Liver in Metabolism

- **Carbohydrate metabolism.**
- **Lipid metabolism.**
- **Protein metabolism.**
- **Processing of drugs and hormones.** The liver can detoxify substances such as alcohol and excrete drugs
- **Excretion of bilirubin.** As previously noted, bilirubin, derived from the heme of aged red blood cells
- **Synthesis of bile salts**
- **Storage:** glycogen, certain vitamins (A, B12, D, E, and K) and minerals (iron and copper)
- **Phagocytosis**
- **Activation of vitamin D.**

Bile

- Produced by cells in the liver

Composition:

- Bile salts
- Bile pigment (mostly bilirubin from the breakdown of hemoglobin)
- Cholesterol
- Phospholipids
- Electrolytes

Gall Bladder

- Sac found in hollow fossa of liver
- Stores bile from the liver by way of the cystic duct
- Bile is introduced into the duodenum in the presence of fatty food
- Gallstones can cause blockages

- تم العثور على كيس في الحفرة المجوفة للكبد
- يخزن الصفراء من الكبد عن طريق

القناة الكيسية

- يتم إدخال الصفراء في الاثني عشر في

وجود الطعام الدهني

- يمكن أن تسبب حصى المرارة انسدادا

Chemical Digestion in the Small Intestine