AL MUSTAQBAL UNIVERSITY

College of Medicine / First Year

ANATOMY

(L4) Joints, Blood Vessels & Lymphatic System

with Back and Scapular Region

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Learning Objectives

By the end of this lecture, students should be able to:

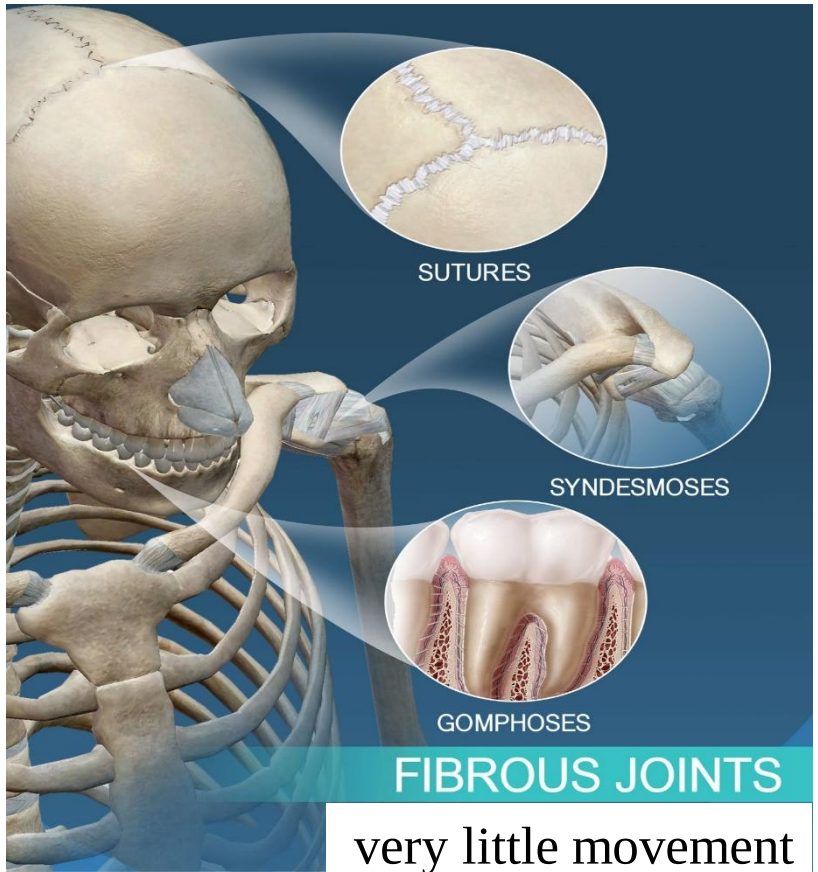
1. **Define and classify joints** with examples.
2. **Describe the structure of synovial joints** and list their types.
3. **State factors affecting joint stability**.
4. **Explain Hilton’s law**.
5. **Differentiate arteries, veins, and capillaries**.
6. **Define anastomosis and end arteries**.
7. **Describe the components and functions of the lymphatic system**.
8. **Explain lymph drainage into the venous system**.
9. **Define lymphedema**.
10. **Identify pectoral, back, and scapular muscles**.
11. **Describe rotator cuff muscles and their function**.
12. **Apply anatomy to common clinical conditions**

Joints

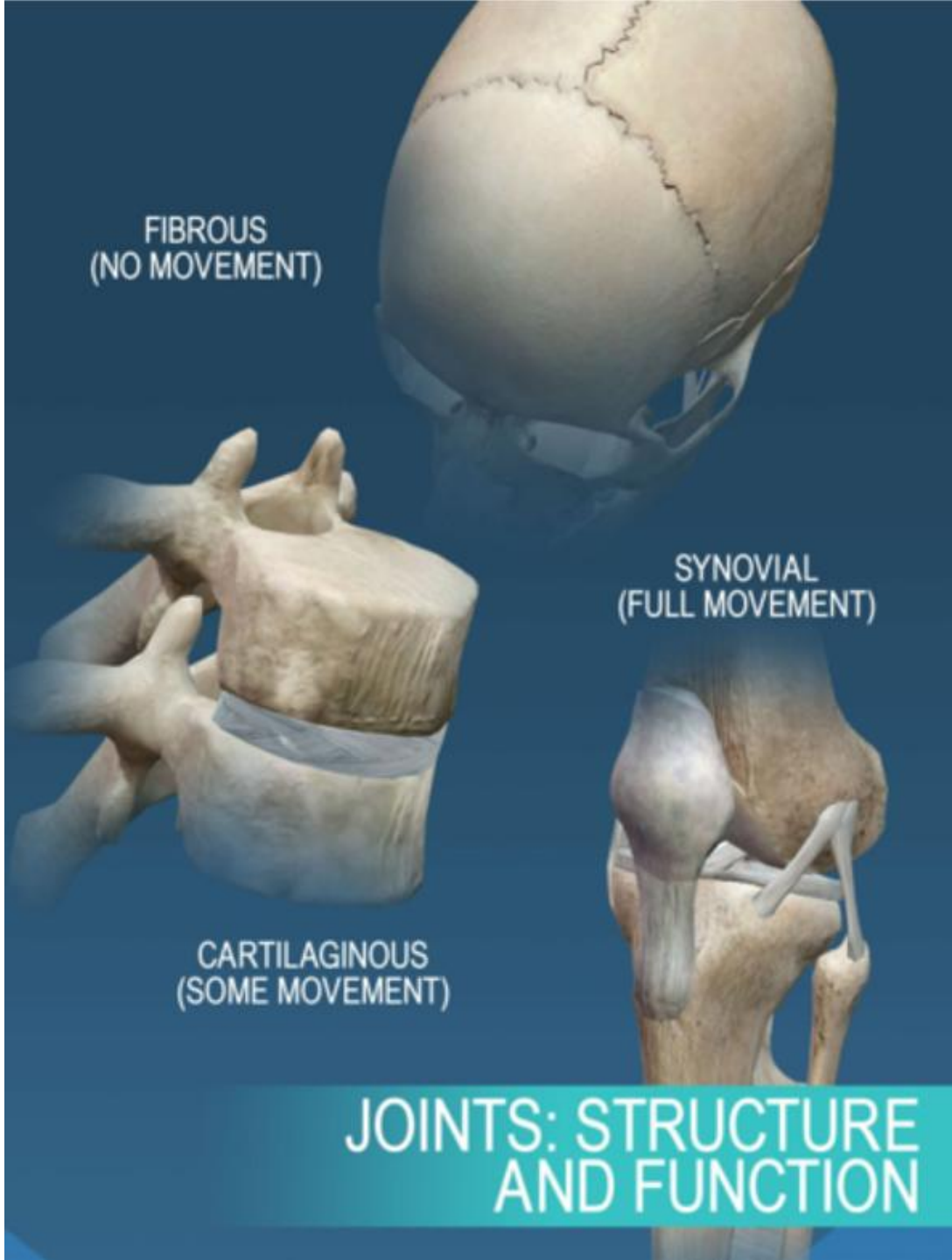
A site where two or more bones come together, whether or not movement occurs between them, is termed a joint.

Joint Classification

The three main types of joints are based on the tissues that lie in the joint space between the bones: fibrous joints, cartilage joints, and synovial joints.



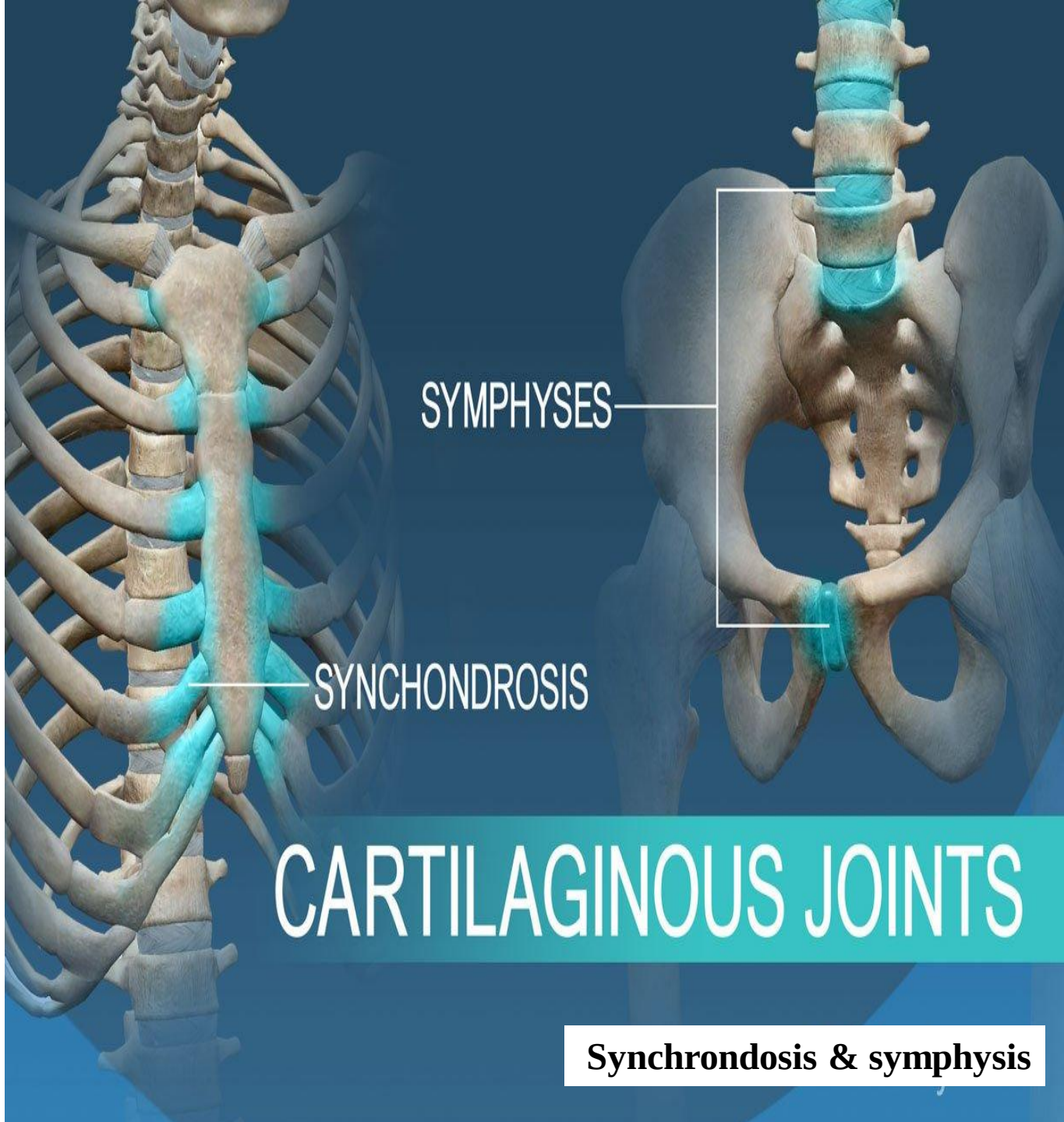
Fibrous Joints: the articulating surfaces of the bones are tightly linked by fibrous tissue that fills the joint space. Thus, very little movement is possible at these joints. The sutures of the vault of the skull and the inferior tibiofibular joints are examples of fibrous joints.



Cartiliginous Joints. Joints that unite bones with cartilage are called cartilaginous joints. The space between the articulating bony surfaces is filled with a cartilaginous pad There are two types of cartilaginous joints:

(1) A **synchrondosis** is an immovable cartilaginous joint. One example is the joint between the first pair of ribs and the sternum.

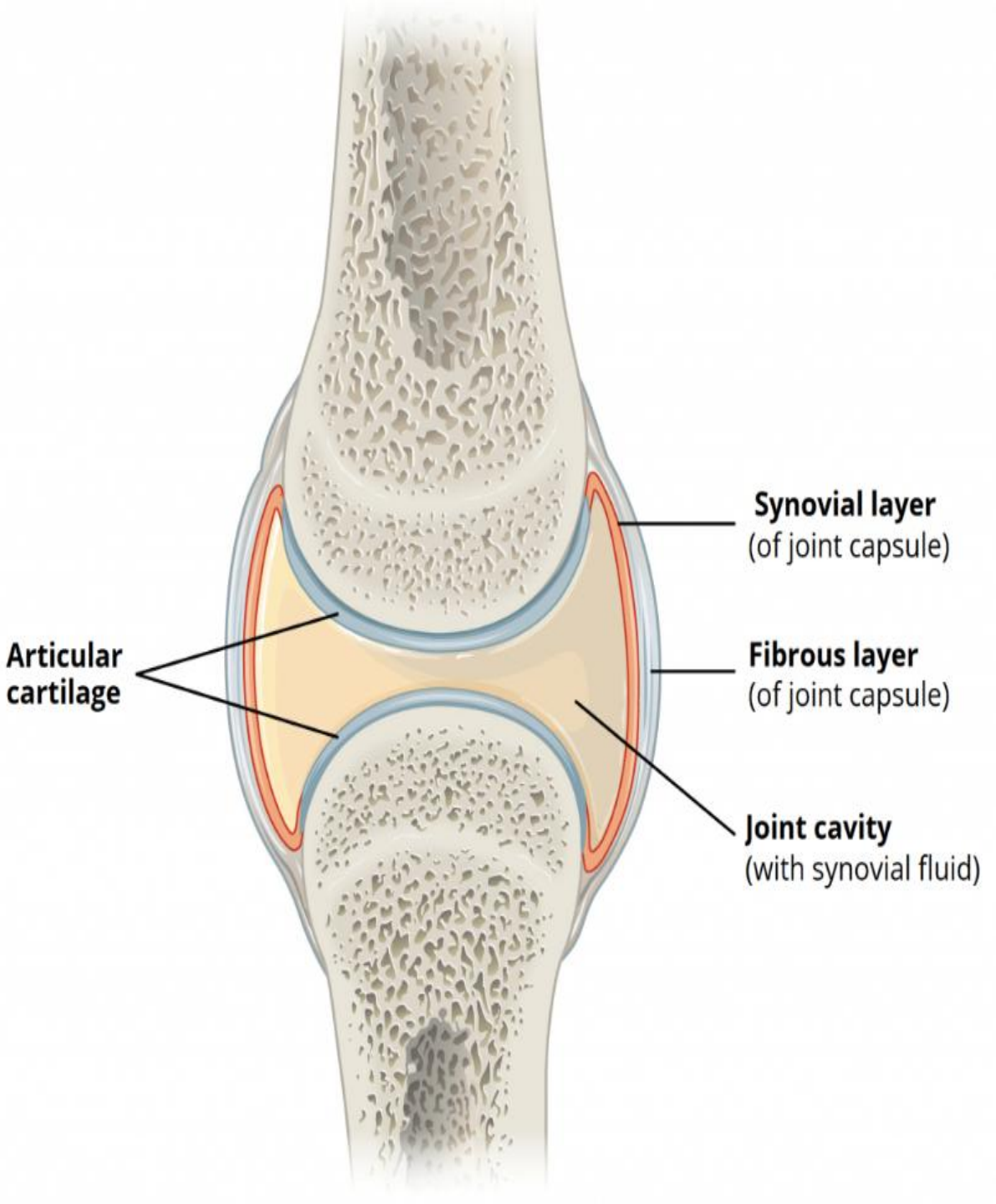
(2) A **symphysis** consists of a compressable fibrocartilaginous pad that connects two bones. This type of joint allows for some movement, e.g., the hip bones, connected by the pubic symphysis, and the vertebrae, connected by intervertebral discs.



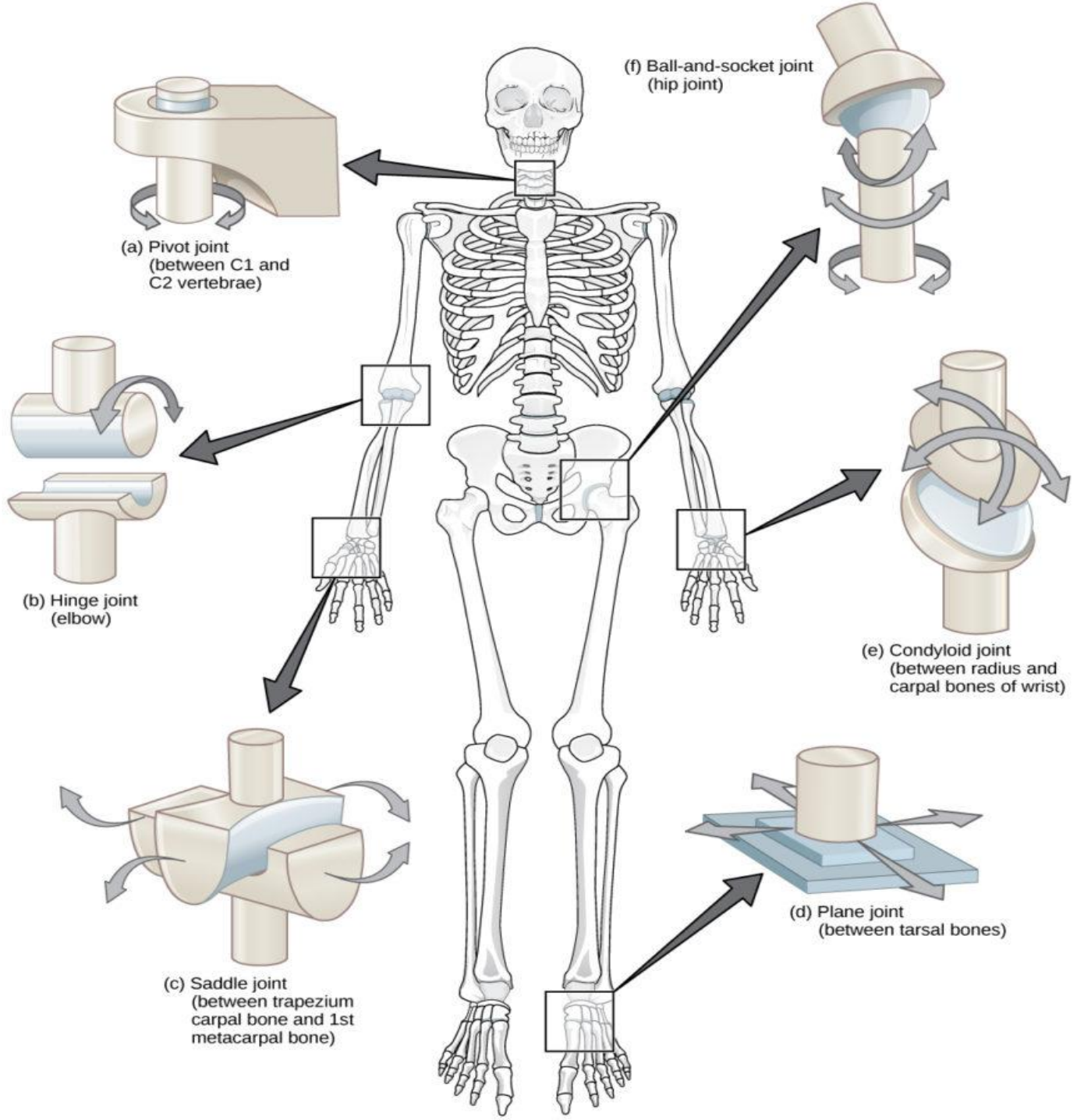
Synchrondosis & symphysis

Synovial Joints

In synovial joints, the **articular surfaces** of the bones are covered by a thin layer of hyaline cartilage and are separated by a fluid-filled joint cavity. This arrangement permits a great degree of freedom of movement. The cavity of the joint is lined by a **synovial membrane**, which extends from the margins of one articular surface to those of the other. A tough fibrous membrane referred to as **the capsule** of the joint protects the exterior of the synovial membrane. A viscous fluid called **synovial fluid**, which is produced by the synovial membrane, lubricates the articular surfaces. In certain synovial joints (e.g., the knee joint, the temporomandibular joint), discs or wedges of fibrocartilage are interposed between the articular surfaces of the bones. These are referred to as articular discs.



The shape of the bones participating in the joint, the **approximation of adjacent anatomic structures** (e.g., the thigh against the anterior abdominal wall on flexing the hip joint), and the **presence of fibrous ligaments** uniting the bones all contribute to **limiting the degree of movement** in a synovial joint. Most ligaments lay outside the joint capsule and are referred to as **extracapsular ligaments**. However, some important ligaments (e.g., the cruciate ligaments in the knee) lie within the capsule and are termed **intracapsular ligaments**. Synovial joints can be classified according to the shapes of the articular surfaces and the types of movements that are possible.



There are six types of synovial joints:

(1) **Gliding or plane** joints move against each other on a single plane. Major gliding joints include the intervertebral joints and the bones of the wrists and ankles.

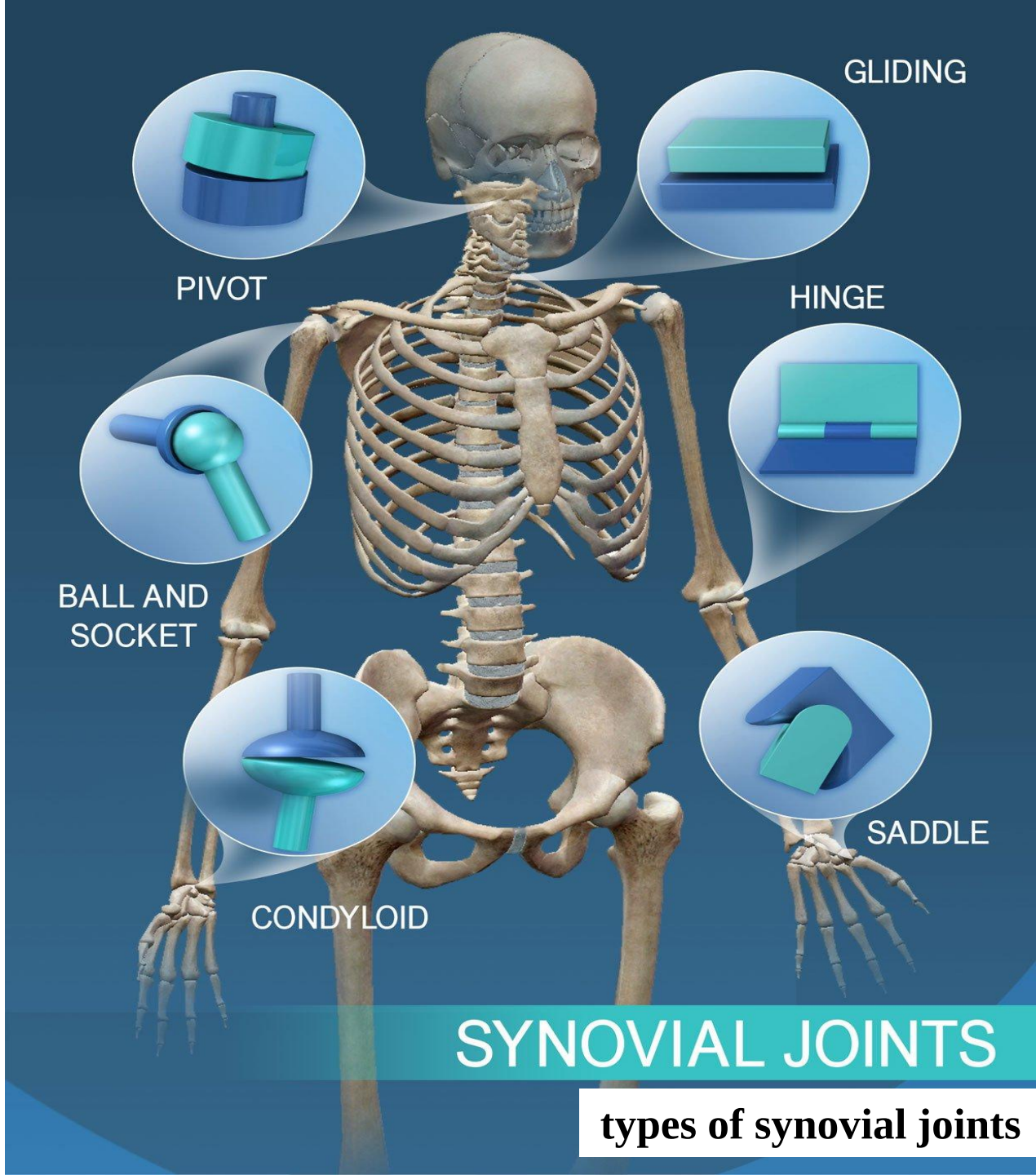
(2) **Hinge** joints move on just one axis. These joints allow for flexion and extension. Major hinge joints include the elbow and finger joints.

(3) A **pivot** joint provides rotation. At the top of the spine, the atlas and axis form a pivot joint that allows for rotation of the head.

(4) A **condyloid** joint allows for circular motion, flexion, and extension. The wrist joint between the radius and the carpal bones is an example.

(5) A **saddle** joint allows for flexion, extension, and other movements, but no rotation. In the hand, the thumb's saddle joint (between the first metacarpal and the trapezium) lets the thumb cross over the palm, making it opposable.

(6) The **ball-and-socket** joint is a freely moving joint that can rotate on any axis. The hip and shoulder joints are examples of ball and socket joints.



types of synovial joints

Joint Stability

The stability of a joint depends on three main factors:

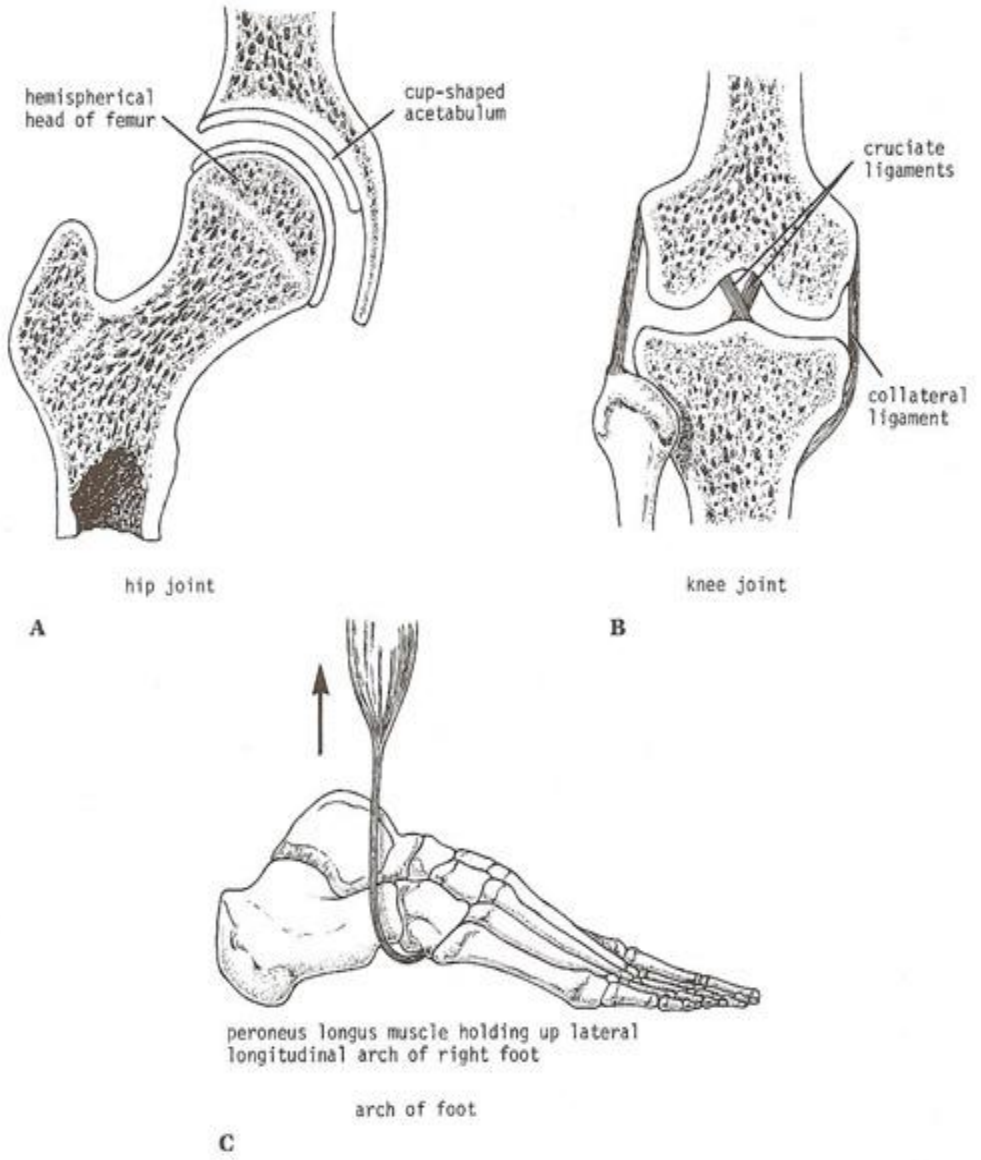
The morphology of the bony articular surfaces

The ligaments: are cord or band of fibrous connective tissue, typically bind bones at joints. The two types of ligaments are fibrous and elastic.

The tone of the muscles around the joint

Joint Nerve Supply

The joint capsule and ligaments receive an abundant sensory nerve supply. A sensory nerve supplying a joint also supplies the muscles moving the joint and the skin overlying the insertions of these muscles, a fact that has been codified as **Hilton's law.**



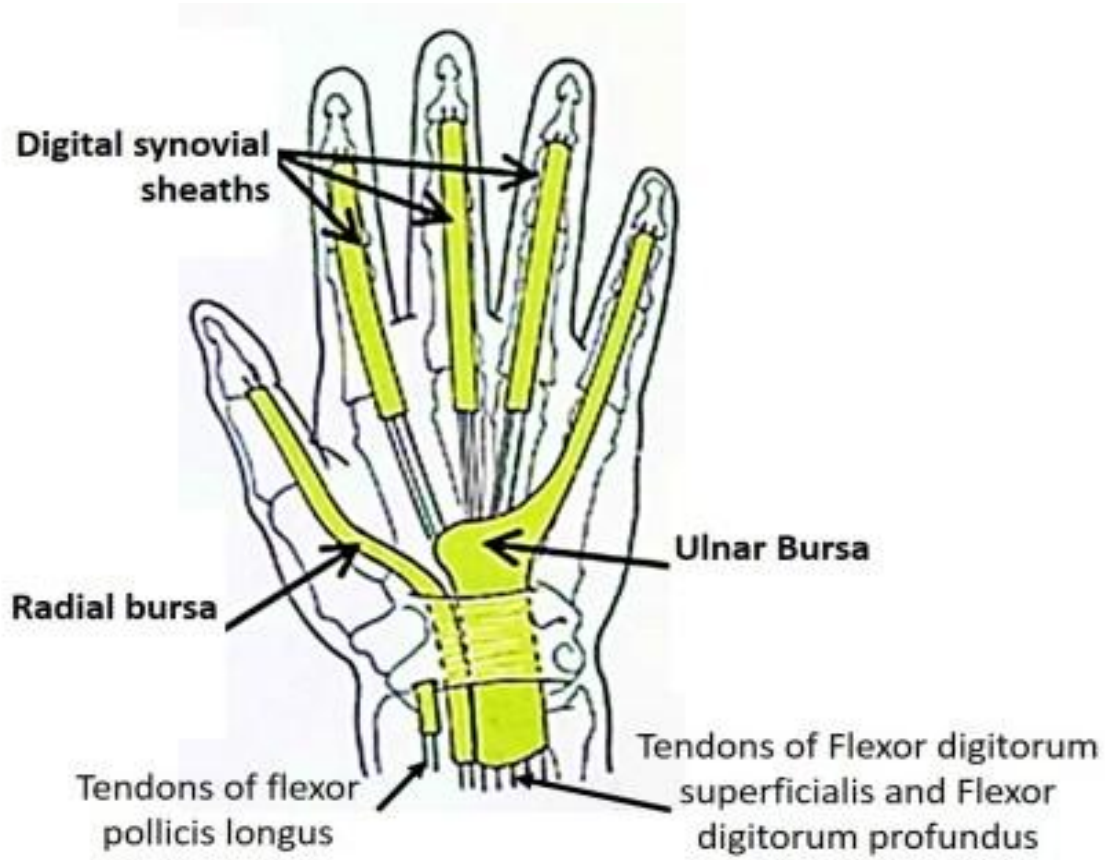
Bursae and Synovial Sheaths

A bursa is a small sac lined by synovial membrane, and filled with synovial fluid. Bursae are located at key points of friction in a joint. They afford joints greater freedom of movement, whilst protecting the articular surfaces from friction-induced degeneration. Occasionally, the cavity of a bursa communicates with the cavity of a synovial joint (e.g., the suprapatellar bursa communicates with the knee joint, and the subscapularis bursa communicates with the shoulder joint).

They can become inflamed following infection or irritation by over-use of the joint **(bursitis).**

A synovial sheath is a tubular bursa that surrounds a tendon.

Synovial sheaths occur where tendons pass under ligaments and retinacula and through osseofibrous tunnels. Their function is to reduce friction between the tendon and its surrounding structures.



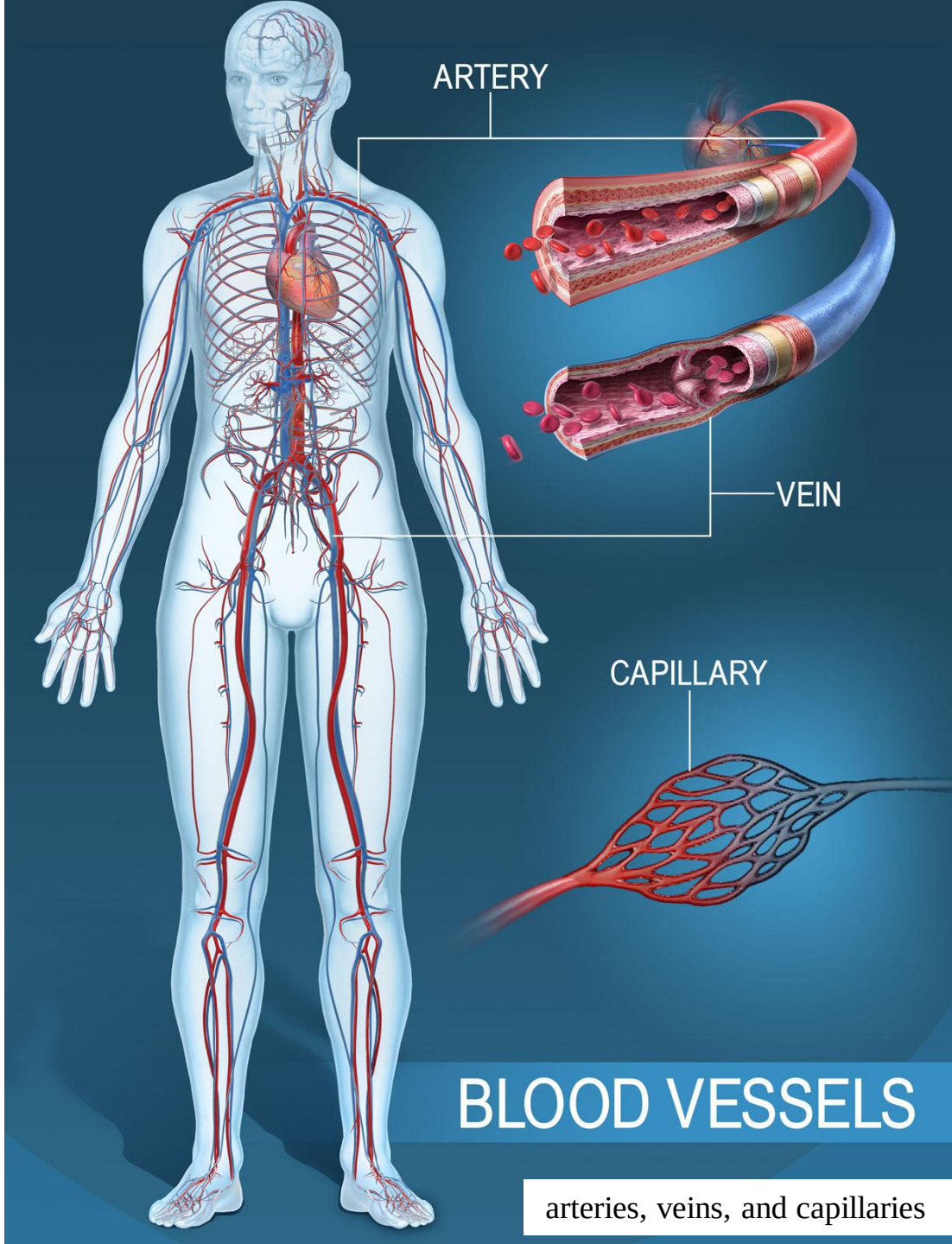
Blood Vessels

The three types of blood vessels are arteries, veins, and capillaries

Arteries

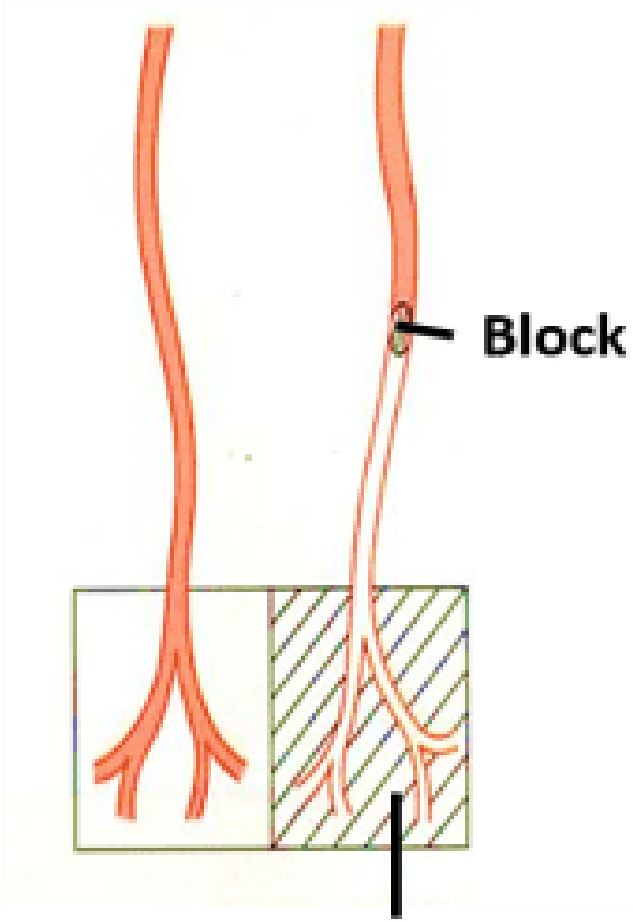
Arteries transport blood away from the heart and distribute it to the various tissues of the body by means of their branches. The smallest arteries (<0.1 mm in diameter) are referred to as **arterioles**. Individual arteries may connect with other arteries via a communicating branch termed an **anastomosis.** Arteries **do not** have valves.

Anatomic end arteries are vessels whose terminal branches do not anastomose with branches of arteries supplying adjacent areas. Therefore, these provide the sole source of blood to a specific target area. Occlusion of an anatomic end artery will result in death of the target tissues. **Functional end arteries** are vessels whose terminal branches do anastomose with those of adjacent arteries; however, the caliber of the anastomosis is insufficient to keep the target tissue alive if one of the arteries becomes blocked. Thus, although some blood may enter a functional end artery, it is not enough blood to be functionally meaningful.



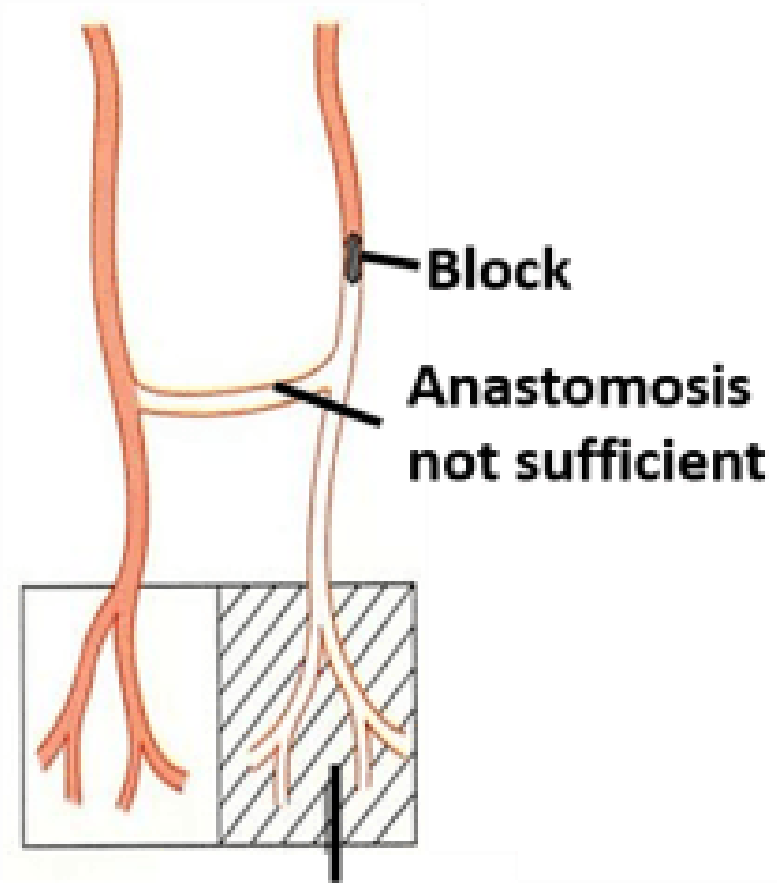
arteries, veins, and capillaries

Anatomic End Arteries



Area supplied by blocked artery undergoes Ischemic necrosis

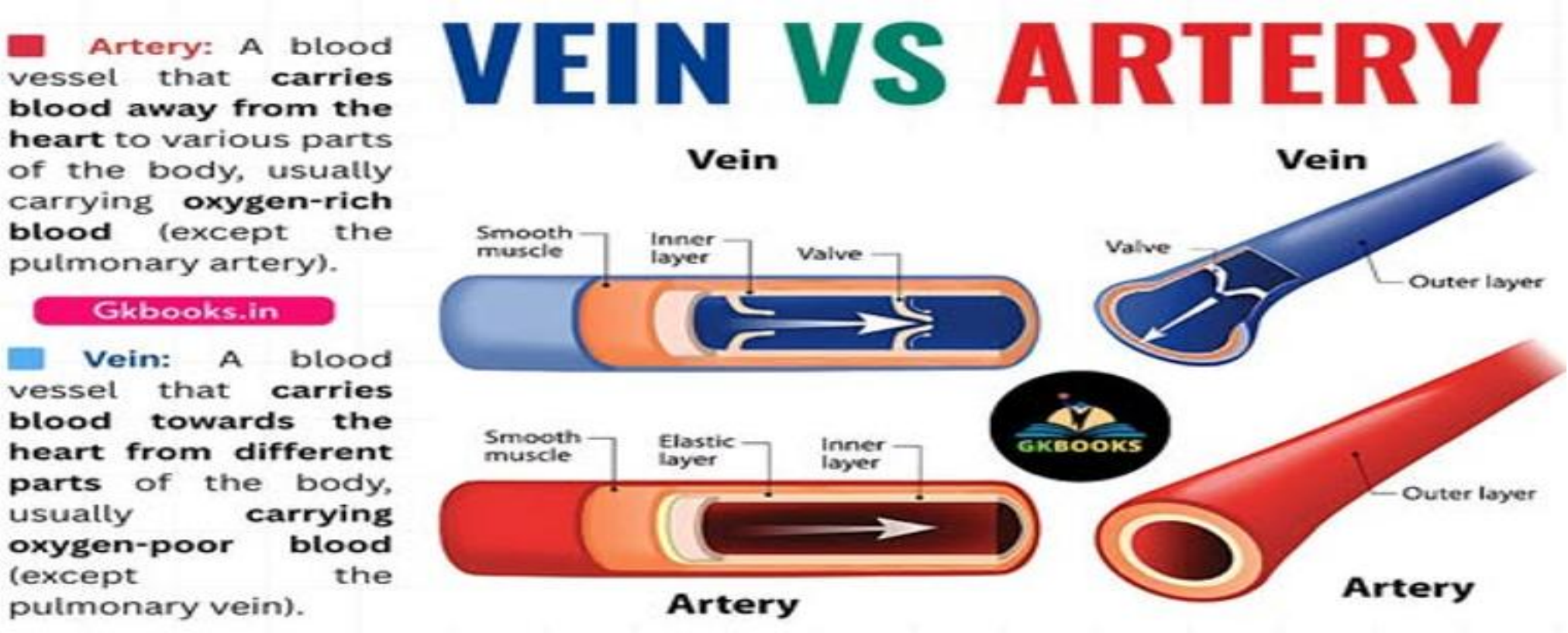
Functional End Arteries



Area supplied by blocked artery undergoes Ischemic necrosis

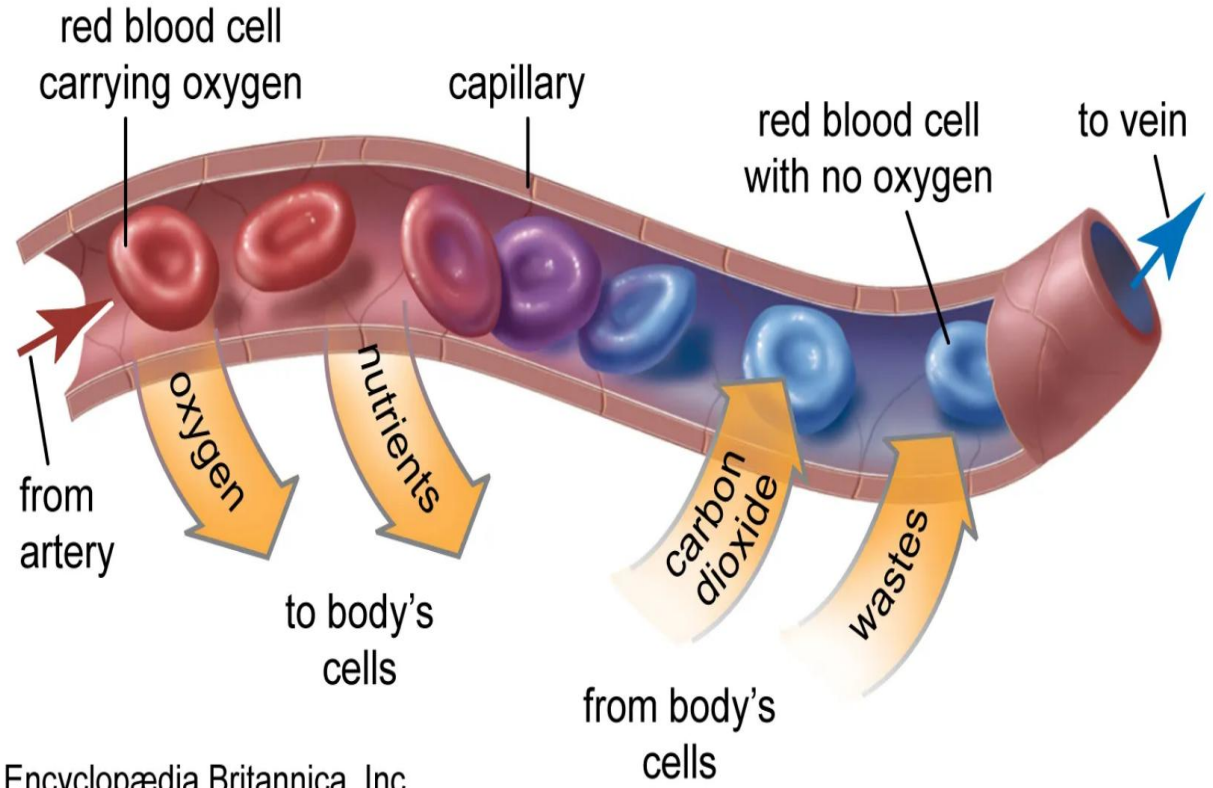
Veins

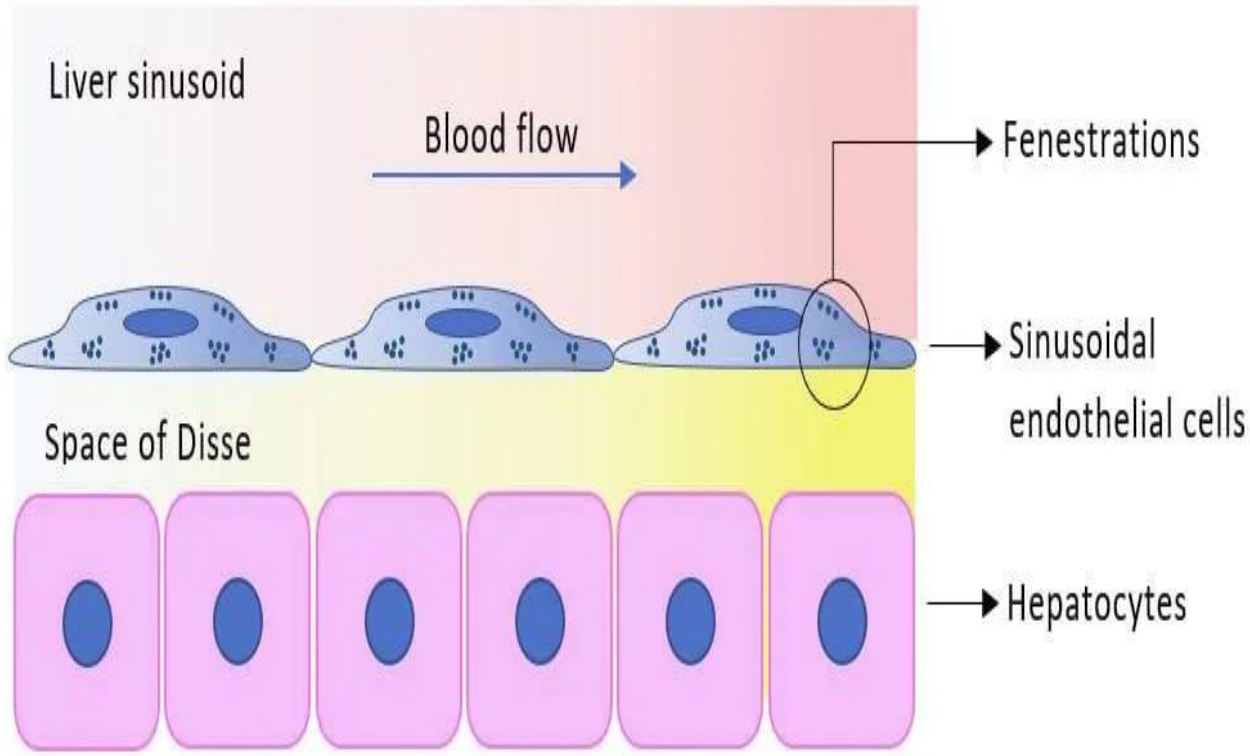
Veins are vessels that transport blood toward the heart. Many veins possess **valves,** which function to prevent reflux of blood. The smallest veins are called **venules.** The smaller veins, or tributaries, unite to form larger veins, which commonly join with one another to form venous plexuses. Veins leaving the gastrointestinal tract do not go directly to the heart but converge on the **portal vein**. This vein enters the liver and breaks up again into veins of diminishing size, which ultimately join capillary-like vessels, termed **sinusoids** in the liver. **A portal system** is thus a system of vessels interposed between two capillary beds.



Capillaries

Capillaries are microscopic vessels in the form of a network connecting the arterioles to the venules. **Sinusoids** resemble capillaries in that they are thin-walled blood vessels, but they have an irregular cross diameter and are wider than capillaries. They are found in the bone marrow, the spleen, the liver, and some endocrine glands. In some areas of the body, principally the tips of the fingers and toes, direct connections occur between the arteries and the veins without the intervention of capillaries. The sites of such connections are referred to as **arteriovenous anastomoses**.





Lymphatic System

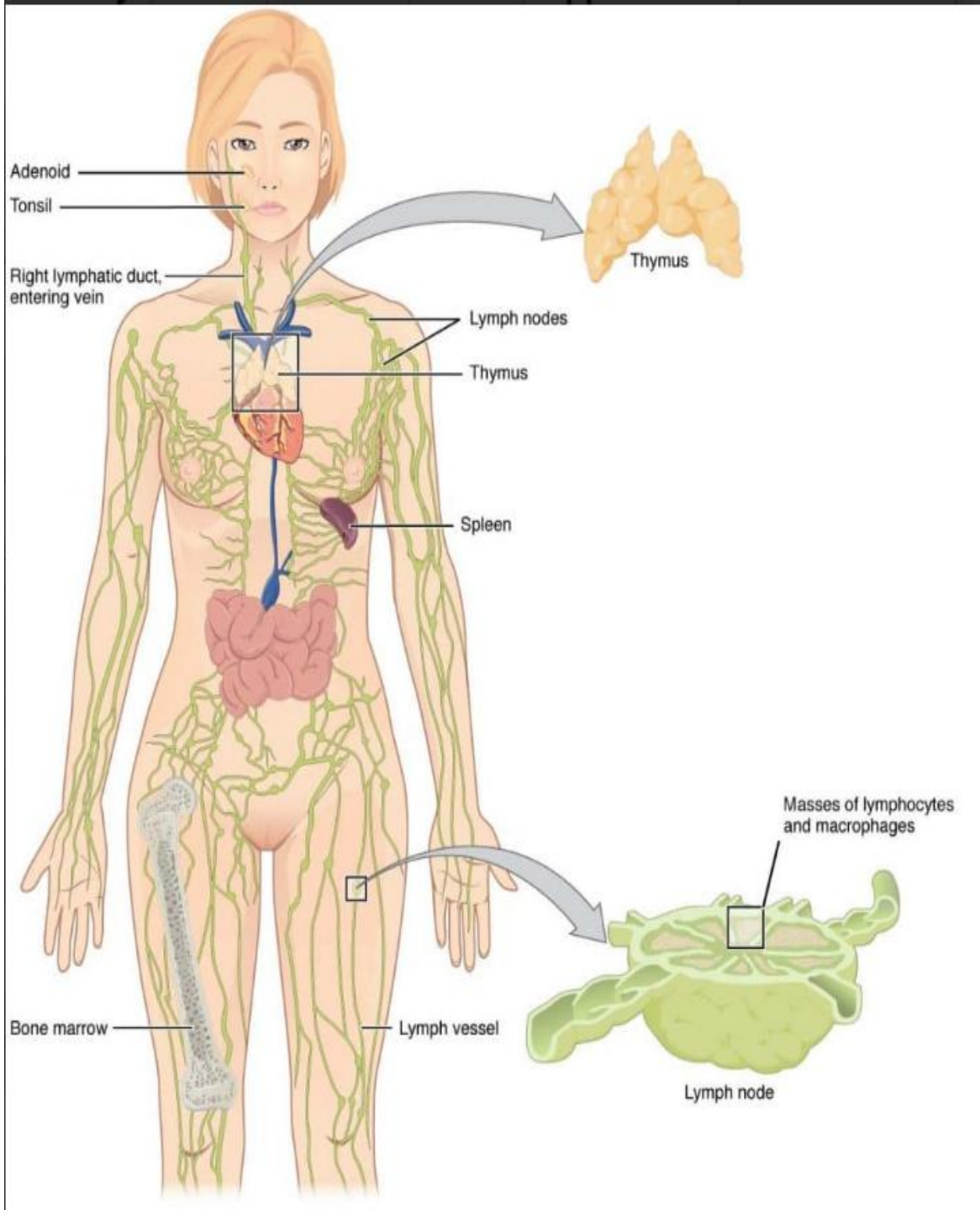
Lymph is a clear, colorless tissue fluid that is collected from tissues throughout the body. It consists of a liquid portion and a cellular portion that is composed mainly of white blood cells (primarily lymphocytes).

Lymph is collected in a vast network of vessels and eventually mostly returned to the venous system. The lymphatic system consists of two major components:

lymphatic organs and **lymphatic vessels.**

The lymphatic organs are the lymph nodes, tonsils, thymus, and spleen. Additionally, localized aggregations of lymphatic tissue (lymph nodules) occur in various places (e.g., mucus membranes, intestinal nodules).

Lymphatic organs are essential for the immunologic defenses of the body against bacteria and viruses. The organs serve to produce lymphocytes; act as barriers to pathogens..

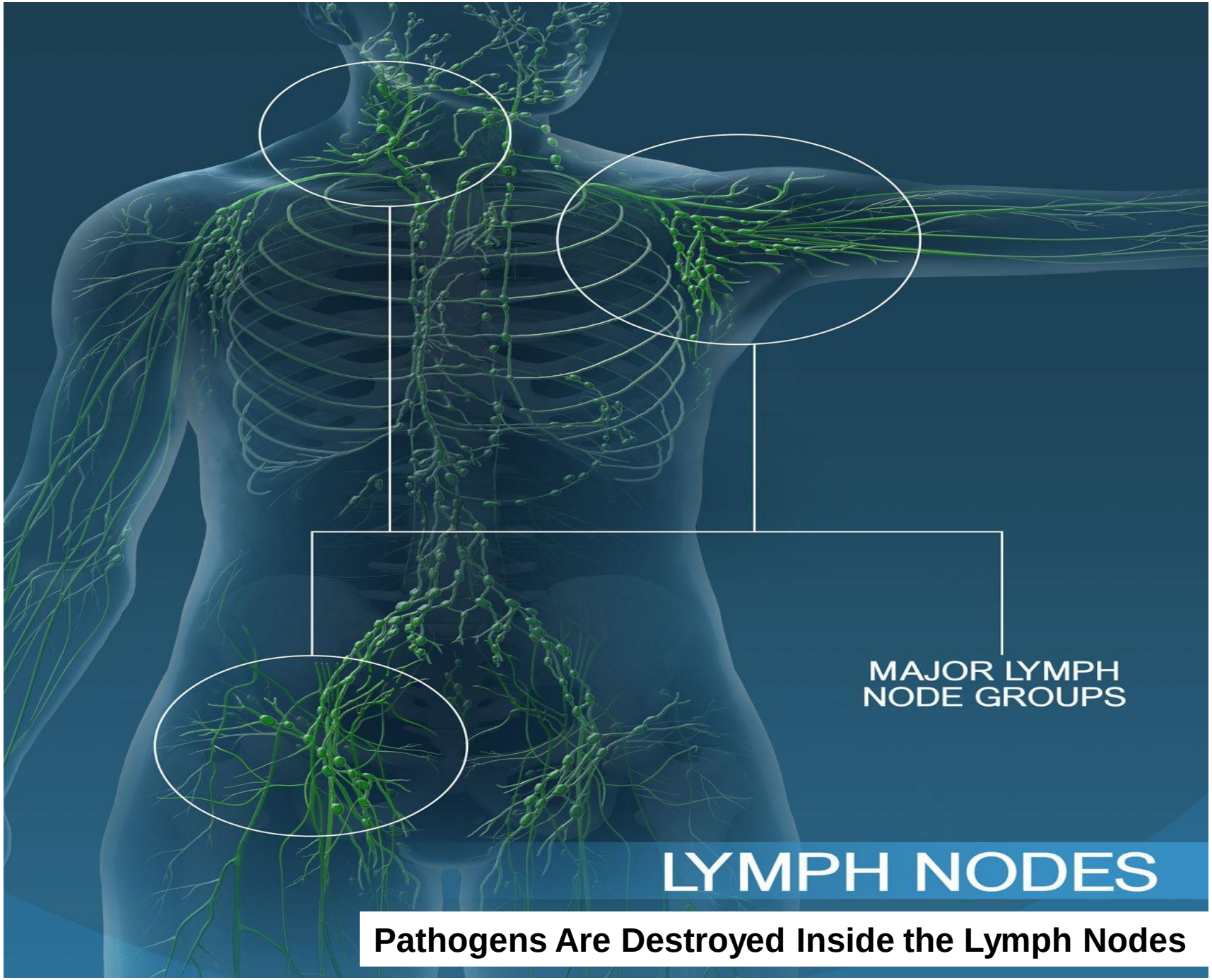


Lymphatic vessels are tubes that assist the cardiovascular system in the removal of tissue fluid from the tissue spaces of the body. These vessels then return the fluid to the blood. The lymphatic system is essentially a drainage system, with no circulation.

Lymphatic vessels are found in all tissues and organs of the body except **cartilage, bone, the CNS, the eyeball, the internal ear, and the epidermis of the skin.**

Lymph capillaries form a network of fine vessels that drain lymph from the tissues. The **capillaries** are larger and more irregular than blood capillaries, possess few valves, and are present in most locations where blood capillaries are found. The lymph capillaries are in turn drained by **small lymphatic collecting vessels**, which unite to form **larger collecting vessels**. The largest collecting vessels are termed the **lymphatic trunks or ducts**.

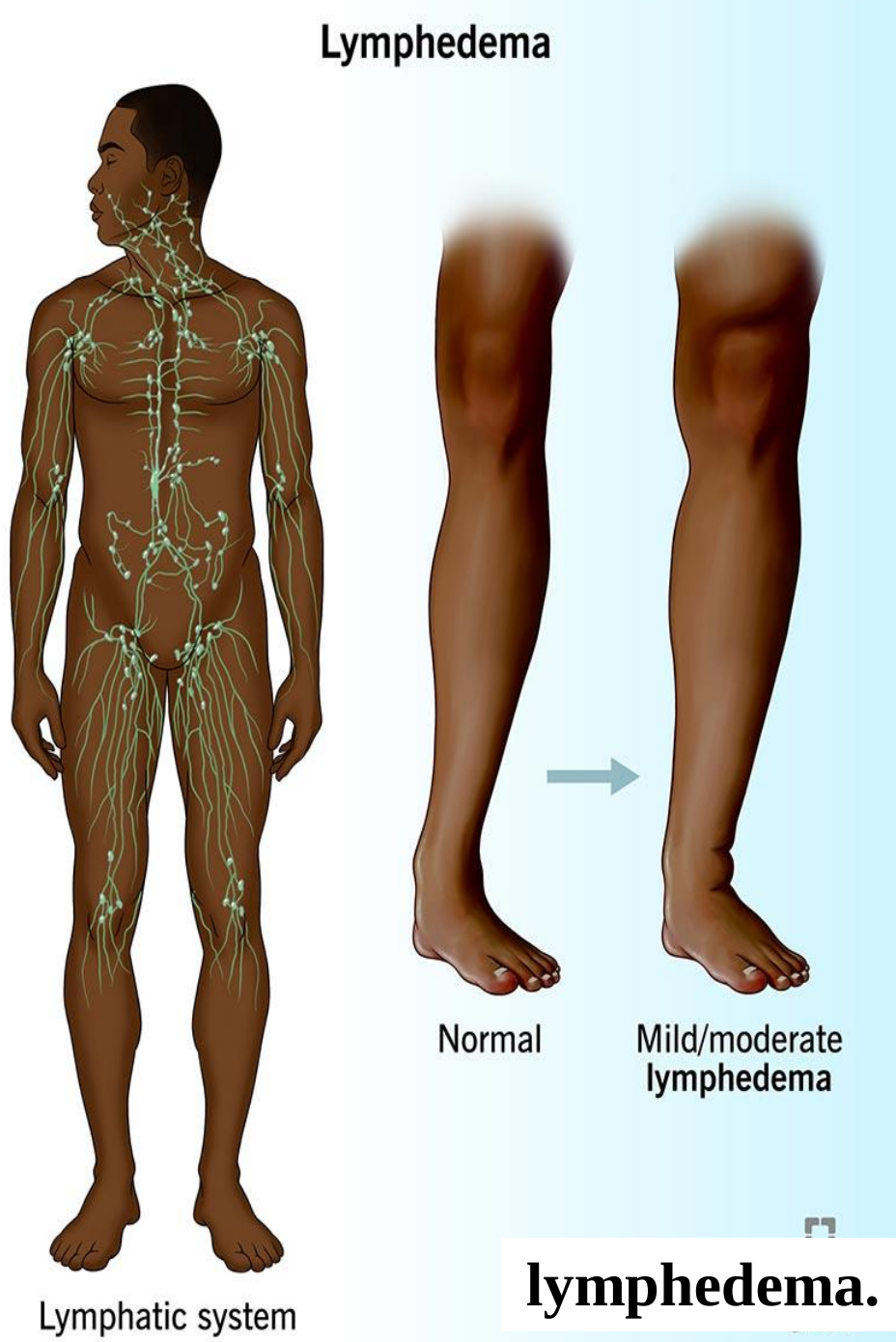
Before lymph is returned to the bloodstream, it passes through at least one **lymph node** and often through several. The lymph vessels that carry lymph to a lymph node are referred to as **afferent** vessels; those that transport it away from a node are **efferent** vessels.


MAJOR LYMPH
NODE GROUPS
LYMPH NODES
Pathogens Are Destroyed Inside the Lymph Nodes

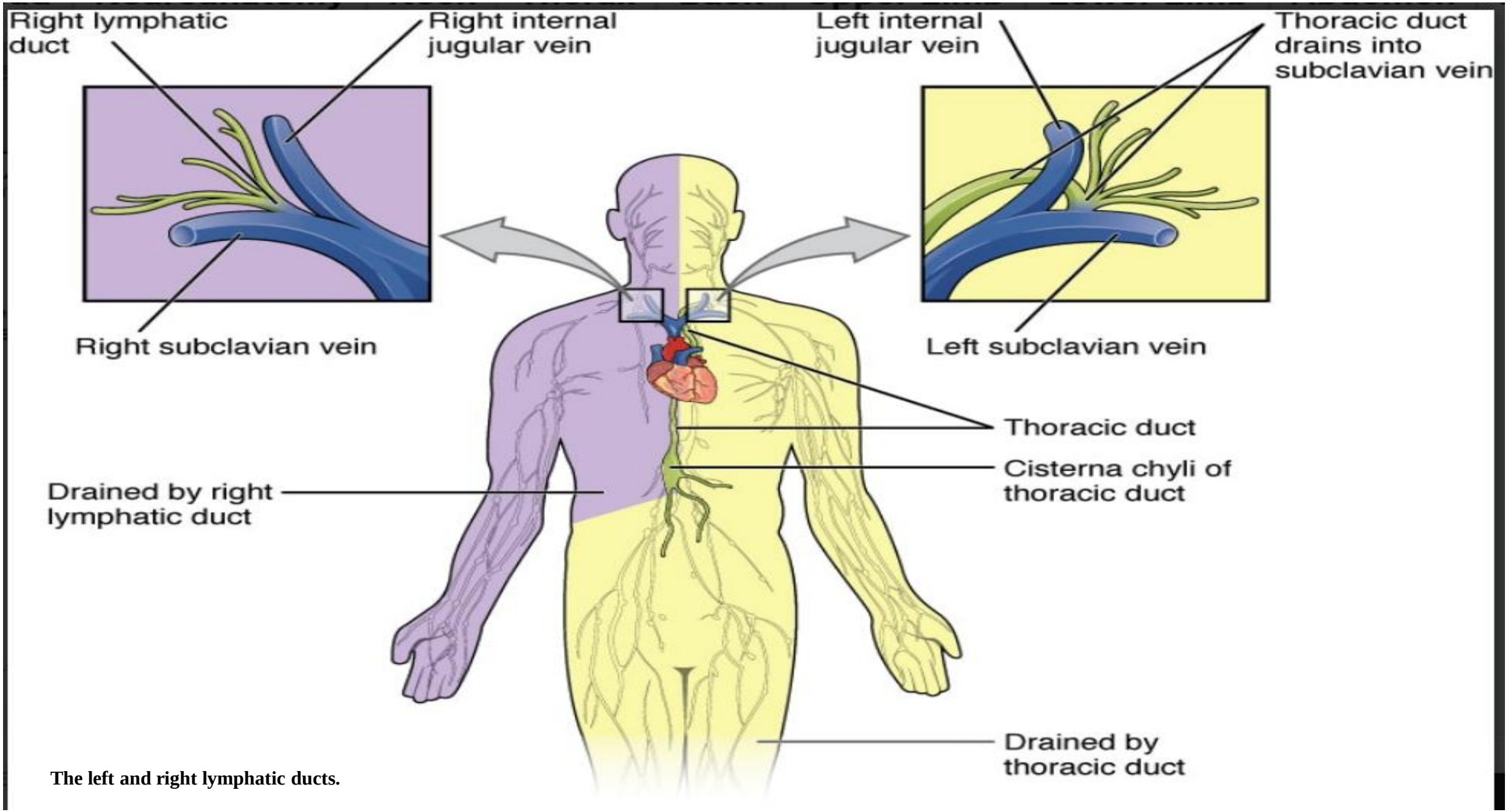
The **flow of lymph** is driven by **extravessel forces**, for example, the pressures produced by contractions of neighboring muscles or the negative pressure produced during inspiration. Obstruction of lymph flow from a given area results in accumulation of tissue fluid in that area. An abnormally large accumulation of fluid is referred to as **lymphedema.**

Almost all lymph eventually drains into the venous system at the junction of the **internal jugular and subclavian veins** in the root of the neck on each side of the body.

Lymph from the upper right quadrant of the body (head, neck, upper limb, and the trunk above the umbilicus) drains into several trunks, which independently enter the venous system on the right side. Sometimes, these vessels unite to form a single right lymphatic duct that then drains into the venous system. Lymph from the rest of the body eventually drains into the thoracic duct, which empties into the left side of the venous system. The arrangement of the lymphatic ducts is extremely variable.



lymphedema.



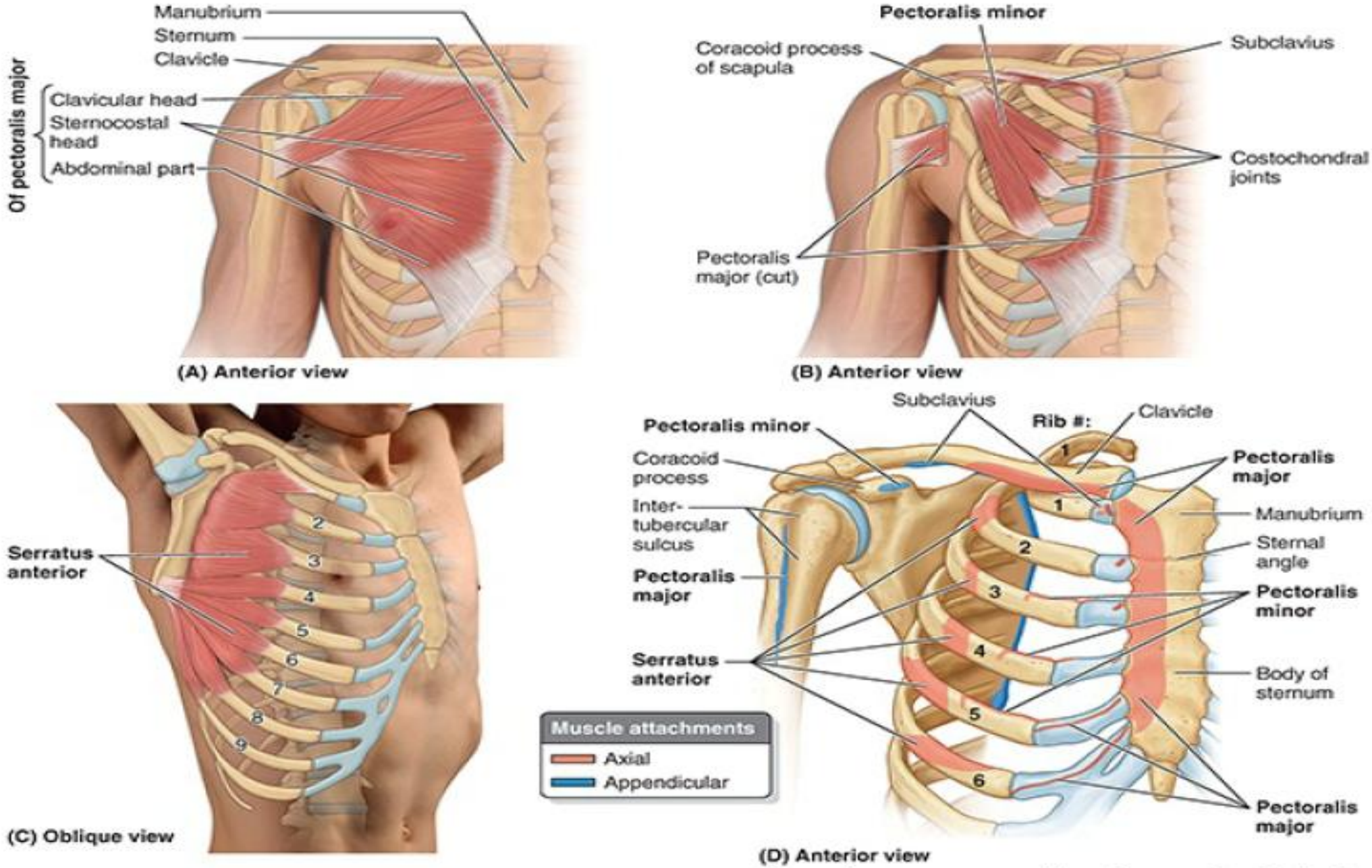
The left and right lymphatic ducts.

Pectoral Muscles : Anterior Axio-Appendicular Muscles : Thoraco-appendicular Muscles

Four anterior axio-appendicular muscles move the pectoral girdle:

pectoralis major, pectoralis minor, subclavius, and serratus anterior.

Muscle	Proximal Attachment	Distal Attachment	Innervation[a]	Main Action
Pectoralis major	Clavicular head: anterior surface of medial half of clavicle Sternocostal head: anterior surface of sternum, superior six costal cartilages, and aponeurosis of external oblique muscle	Lateral lip of intertubercular sulcus of humerus	Lateral and medial pectoral nerves; clavicular head (C5, **C6**), and sternocostal head (**C7**, **C8**, T1)	Adducts and medially rotates humerus; draws scapula anteriorly and inferiorly Acting alone, clavicular head flexes humerus and sternocostal head extends it from the flexed position
Pectoralis minor	3rd–5th ribs near their costal cartilages	Medial border and superior surface of coracoid process of scapula	Medial pectoral nerve (C8, T1); Lat. pectoral n. (variable)	Stabilizes scapula by drawing it inferiorly and anteriorly against thoracic wall
Subclavius	Junction of 1st rib and its costal cartilage	Inferior surface of middle third of clavicle	Nerve to subclavius (**C5**, C6)	Anchors and depresses clavicle
Serratus anterior	External surfaces of lateral parts of 1st–8th ribs	Anterior surface of medial border of scapula, including superior and inferior angles	Long thoracic nerve (C5, **C6**, **C7**)	Protracts scapula and holds it against thoracic wall; rotates scapula



Pectoral Muscles **Anterior axio-appendicular muscles. A.** Pectoralis major. **B.** Pectoralis minor and subclavius. **C.** Serratus anterior. **D.** Bony attachments.

Back and Scapular Region

The group of muscles of **the back,** also called **Posterior Axio-Appendicular** (The Back Muscles**: Superficial:** trapezius, latissimus dorsi**, Deep:** levator scapulae, rhomboid major, rhomboid minor**,** connects the **shoulder girdle** (appendicular skeleton) with the **vertebral column** (axial skeleton)**.**

•Scapular Region

The muscles of the **scapular** region also called **Scapulohumeral** connect the shoulder girdle with the upper part of the humerus and are largely concerned with abduction and rotation of the arm. These are: **deltoid, teres major**, **supraspinatus, infraspinatus, teres minor, and subscapularis**, relatively short muscles that pass from the scapula to the humerus and act on the glenohumeral joint.

. POSTERIOR AXIO-APPENDICULAR MUSCLES

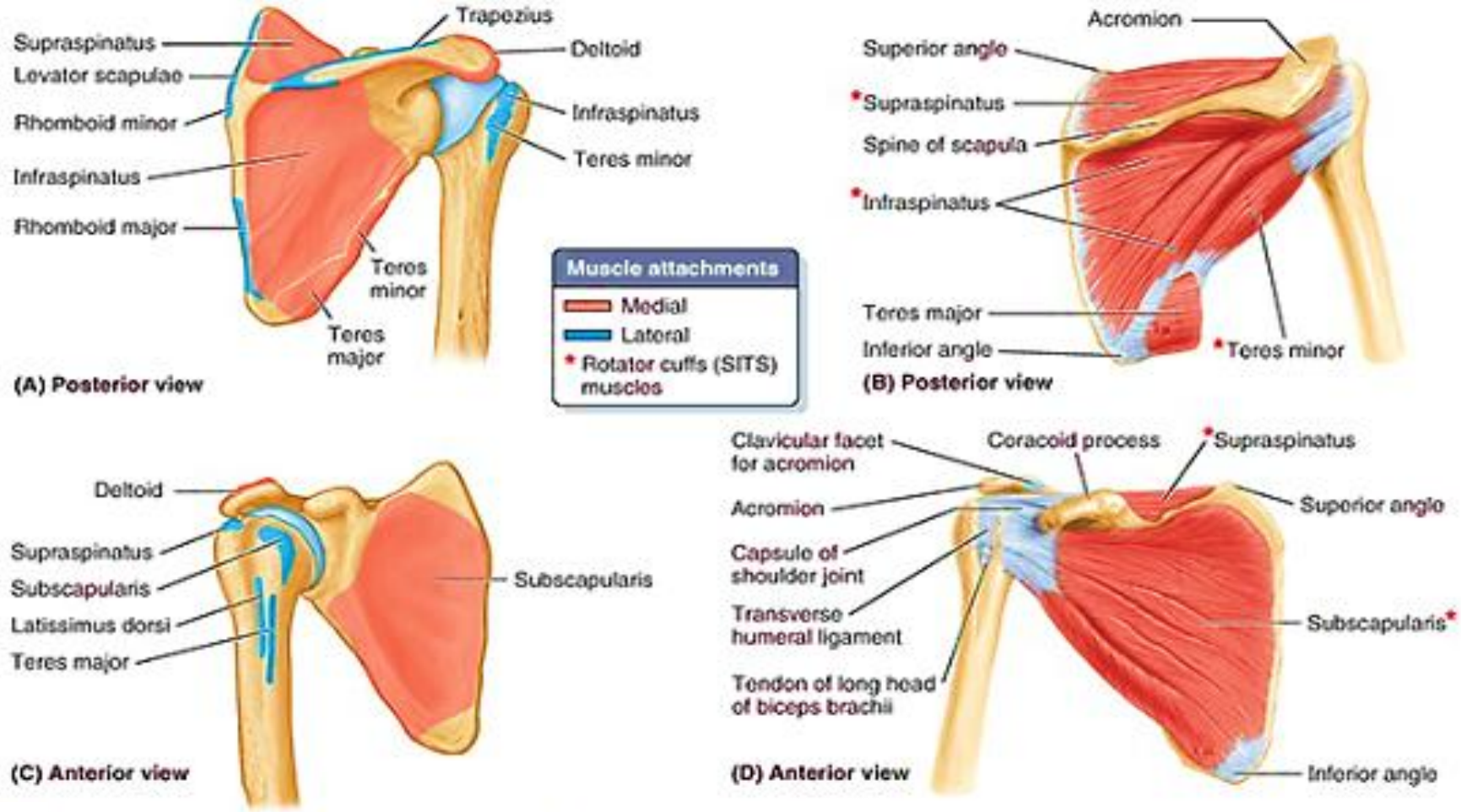
Muscle	Proximal Attachment	Distal Attachment	Innervation[a]	Muscle Action
Superficial posterior axio-appendicular (extrinsic shoulder) muscles				
Trapezius	Medial third of superior nuchal line; external occipital protuberance; nuchal ligament; spinous processes of C7–T12 vertebrae	Lateral third of clavicle; acromion and spine of scapula	Spinal accessory nerve (CN XI) (motor fibers) and C3, C4 spinal nerves (pain and proprioceptive fibers)	Descending part elevates; ascending part depresses; and middle part (or all parts together) retracts scapula; descending and ascending parts act together to rotate glenoid cavity superiorly
Latissimus dorsi	Spinous processes of inferior 6 thoracic vertebrae, thoracolumbar fascia, iliac crest, and inferior 3 or 4 ribs	Floor of intertubercular sulcus of humerus	Thoracodorsal nerve (**C6**, **C7**, C8)	Extends, adducts, and medially rotates humerus; raises body toward arms during climbing
Deep posterior axio-appendicular (extrinsic shoulder) muscles				
Levator scapulae	Posterior tubercles of transverse processes of C1–C4 vertebrae	Medial border of scapula superior to root of scapular spine	Dorsal scapular (C4, C5) and cervical (C3, C4) nerves	Elevates scapula and rotates its glenoid cavity inferiorly by rotating scapula
Rhomboid minor and major	Minor: nuchal ligament; spinous processes of C7 and T1 vertebrae Major: spinous processes of T2–T5 vertebrae	Minor: smooth triangular area at medial end of scapular spine Major: medial border of scapula from level of spine to inferior angle	Dorsal scapular nerve (C4, **C5**)	Retract scapula and rotate its glenoid cavity inferiorly; fix scapula to thoracic wall

Scapular

Muscle	Proximal Attachment	Distal Attachment	Innervation[a]	Muscle Action
Deltoid	Lateral third of clavicle; acromion and spine of scapula	Deltoid tuberosity of humerus	Axillary nerve (**C5**, C6)	Clavicular (anterior) part: flex medially rotates arm Acromial (middle) part: abduc Spinal (posterior) part: extend laterally rotates arm
Supraspinatus[b]	Supraspinous fossa of scapula	Superior facet of greater tubercle of humerus	Suprascapular nerve (C4, **C5**, C6)	Initiates and assists deltoid in abduction of arm and acts wit other rotator cuff muscles[b]
Infraspinatus[b]	Infraspinous fossa of scapula	Middle facet of greater tubercle of humerus	Suprascapular nerve (**C5**, C6)	Laterally rotates arm; and acts other rotator cuff muscles[b]
Teres minor[b]	Middle part of lateral border of scapula	Inferior facet of greater tubercle of humerus	Axillary nerve (**C5**, C6)	Laterally rotates arm; and acts other rotator cuff muscles[b]
Teres major	Posterior surface of inferior angle of scapula	Medial lip of intertubercular sulcus of humerus	Lower subscapular nerve (C5, **C6**)	Adducts and medially rotates
Subscapularis[b]	Subscapular fossa (most of anterior surface of scapula)	Lesser tubercle of humerus	Upper and lower subscapular nerves (C5, **C6**, C7)	Medially rotates arm; as part cuff, helps hold head of hume glenoid cavity

a:The spinal cord segmental innervation is indicated (e.g., "C5, C6" means that the nerves supplying the deltoid are derived from the fifth and sixt segments of the spinal cord). Numbers in boldface (e.g., **C5**) indicate the main segmental innervation.

b:Collectively, the supraspinatus, infraspinatus, teres minor, and subscapularis muscles are referred to as the rotator cuff, or SITS,muscles. Their pr function during all movements of the glenohumeral (shoulder) joint is to hold the humeral head in the glenoid cavity of the scapula

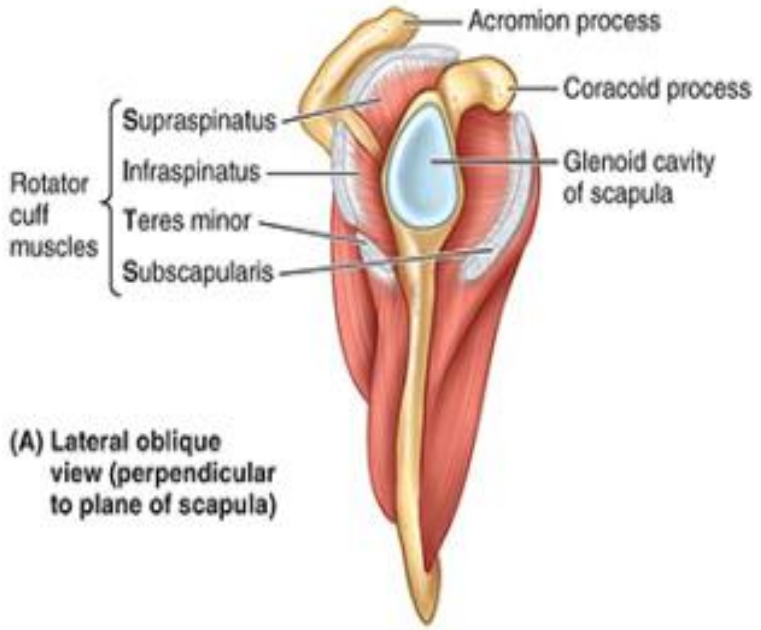


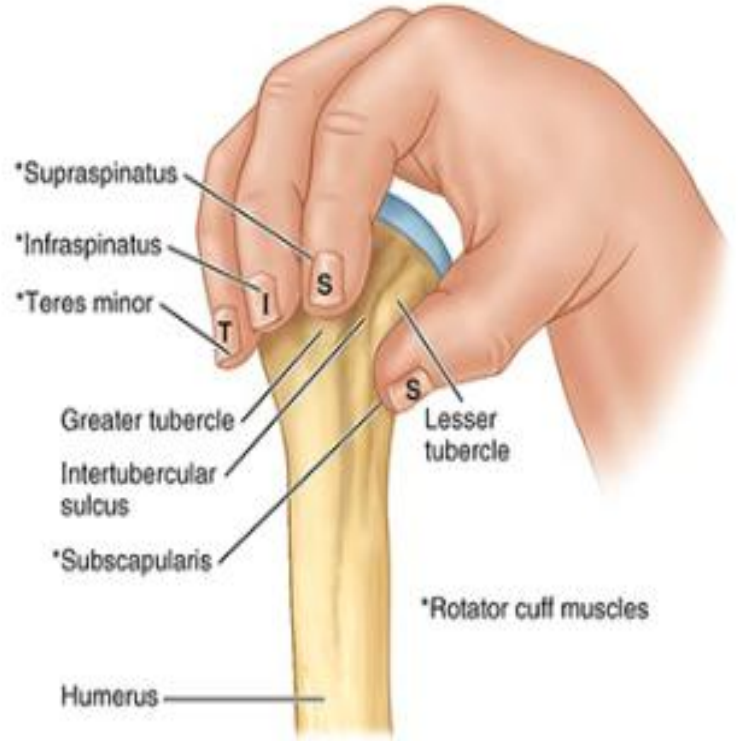
Scapular: **Scapulohumeral muscles. A–D.** These muscles pass from the scapula to the humerus and act on the glenohumeral joint.

Rotator Cuff

The tendons of the subscapularis, supraspinatus, infraspinatus, and teres minor muscles are fused to the underlying capsule of the shoulder joint.

Because of this relationship, these four muscles are referred to as the "rotator cuff." The cuff plays a very important role in stabilizing the glenohumeral (shoulder) joint. The tone of these muscles assists in holding the head of the humerus in the glenoid cavity of the scapula during movements at the shoulder joint. The cuff lies on the anterior, superior, and posterior aspects of the joint. The cuff is deficient inferiorly, and this is a site of potential weakness.





(B)

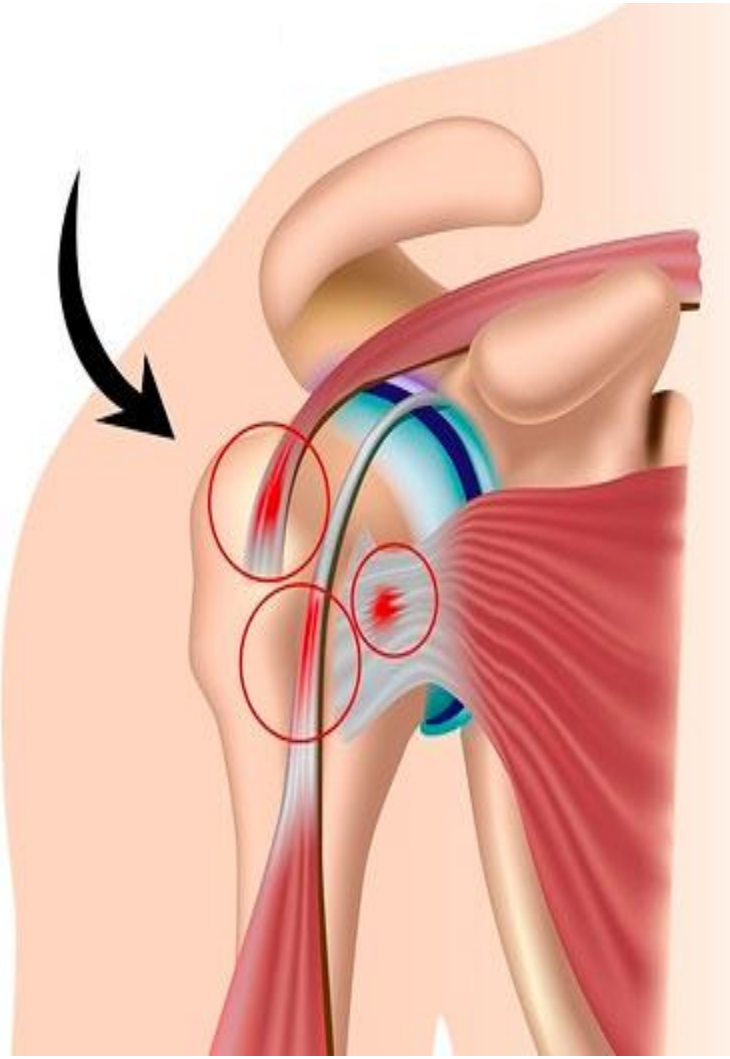
Disposition of rotator cuff muscles

A. Relationship to glenoid fossa. Coming from opposite sides and three separate fossae on the scapulae, the four rotator cuff (SITS) muscles pass laterally to engulf the head of the humerus.

B. Attachments to greater and lesser tubercles. The primary combined function of the four SITS muscles is to "grasp" and pull the relatively large head of the humerus medially, holding it against the smaller, shallow glenoid cavity of the scapula. The tendons of the muscles (represented by three fingers and the thumb) blend with the fibrous layer of the capsule of the shoulder joint to form a musculotendinous rotator cuff, which reinforces the capsule on three sides (anteriorly, superiorly, and posteriorly) as it provides active support for the joint.

Clinical Notes; Rotator Cuff Tendinitis

Lesions of the rotator cuff are a common cause of pain in the shoulder region. Failure of the cuff is due to either wear or tear. Wear is age related. Inflammation or tearing is associated with excessive repetitive use. Overused overhead movements of the upper limb, such as seen in baseball pitchers, tennis players, and swimmers, may be the cause of tendinitis, although many cases appear spontaneously. **The supraspinatus** is the most commonly injured muscle in the rotator cuff. During abduction of the shoulder joint, the supraspinatus tendon is exposed to friction against the acromion. Under normal conditions, the amount of friction is reduced to a minimum by the large subacromial bursa, which extends laterally beneath the deltoid. Degenerative changes in the bursa are followed by degenerative changes in the underlying supraspinatus tendon, and these may extend into the other tendons of the rotator cuff. Clinically, the condition is known as **subacromial bursitis, supraspinatus tendinitis, or pericapsulitis**. It is characterized by the presence of a spasm of pain in the middle range of abduction, when the diseased area impinges on the acromion. Extensive acute traumatic tears are best repaired **surgically** as soon as possible. Small chronic cuff injuries are best managed without surgery using **nonsteroidal anti-inflammatory drugs and muscle exercises.**



THANK YOU!