MD Program
UNIVERSITY OF TORONTO

Anatomy

UNIT 3: The Cardiorespiratory System

Lab 7

CLICK TO ENTER

Unit 3 Overview

Unit 3 describes the anatomy of the cardiorespiratory system. It will build on your introduction to the thorax in Unit 1, Lab 2. Over the course of three labs, you will have the opportunity to study, through dissection and exploration, i) the anatomy of the heart, internal and external, including the coronary circulation, ii) the skeleton and fascial compartments of the limbs, and the peripheral vascular system, iii) the detailed anatomy of the superior and posterior mediastinum, and iv) the lungs, pleural cavity and the mechanics of respiration.

The skeleton is quite sensibly divided into an **axial division** and an **appendicular division**. You've already studied the axial division, consisting of the vertebral column (including the bony thorax), and the skull, in Units 1 and 2, respectively. In Unit 3, you will study the appendicular skeletons of the upper and lower limbs. You are learning the skeleton of the limbs at this point because so much of the language of anatomy (and therefore medicine), including its vasculature, is based on the names of its bones. In Lab 7 you will learn the skeleton of the lower limb. In Lab 8, you will continue with the skeleton of the upper limb.

Note that the anatomy of the musculoskeletal system will be studied in CPC-2, next September, and it is then that you will learn about articulations, muscles and innervation of the limbs. Your current objectives in Unit 3 are to learn the skeleton, fascial compartments and blood supply of the limbs.

Lab 7 Instructions

Lab 7 is a full-day lab. A Lab RAT based on the prelab SLM will be held at 9:00 am and at 1:00 pm. Arrive early to avoid disappointment! That way, if you have difficulty logging into the app on your phone you'll have time to log in using one of the computers in the lab.

Each pair will start with the exercise that corresponds to their pair number (i.e. pair 1 will start with exercise 7.1, pair 2 with 7.2, etc.). Pairs will have 90 minutes to complete the tasks associated with a given station before the TA announces that it is time to rotate to the next station.

	9:00-10:30	10:30-12:00	12:00 - 1:00	1:00-2:25	2:25 - 3:50
7.1 Bones of the LL	Pairs 1	Pairs 4	LUNCH	Pairs 3	Pairs 2
7.2 (Cadaver 1)	Pairs 2	Pairs 1	LUNCH	Pairs 4	Pairs 3
7.3 Fascia & Vessels	Pairs 3	Pairs 2	LUNCH	Pairs 1	Pairs 4
7.4 (Cadaver 2)	Pairs 4	Pairs 3	LUNCH	Pairs 2	Pairs 1

Exercise 7.2 / 7.4 is a dissection of the superior mediastinum.

It is to be completed on both Cadaver 1 and Cadaver 2.

Pairs 2 will start on **Cadaver 1**. **Pairs 4** will start on **Cadaver 2**. There are slight differences as to how the dissection is to be carried out on the two cadavers; these differences are described within the exercise. This dissection should take the entire six hours to complete, and therefore you are expected to go back and review both dissections throughout the course of the day, as time permits.

Unit 3: Lab 7

Select an exercise to begin:

LAB INSTRUCTIONS

Lab 7

7A PRELAB SLM

7.1 THE SKELETON OF THE LOWER LIMB

7.2 DISSECTION OF THE SUPERIOR MEDIASTINUM

7.3 FASCIAL COMPARTMENTS AND VASCULATURE OF THE LOWER LIMB

7.4 DISSECTION OF THE SUPERIOR MEDIASTINUM

7.5 FIELD TRIP

7A Prelab SLM

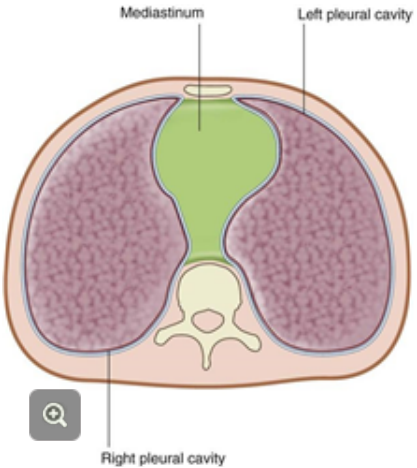
Part 1: Introduction to the Superior Mediastinum

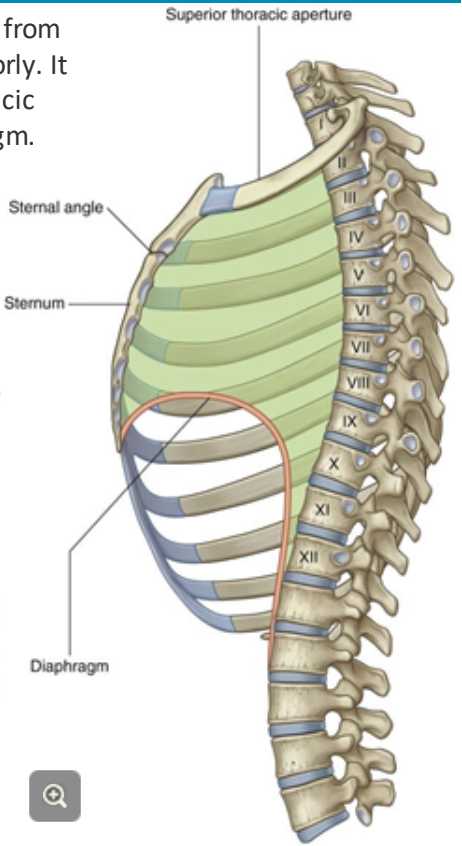
When you have learned the material presented in this exercise, you will be able to:

- describe the limits of the superior mediastinum
- describe the contents of the superior mediastinum and their relative positions

The **mediastinum** is the region between the pleural cavities. It extends from the sternum, anteriorly, to the bodies of the thoracic vertebrae, posteriorly. It extends from the superior thoracic aperture, above, to the inferior thoracic aperture, below. The inferior thoracic aperture is closed by the diaphragm.

The mediastinum contains **viscera** such as the thymus gland, the pericardial sac and the heart, the trachea, and the roots of the great vessels. It also contains structures passing through the thorax to or from the abdomen and neck, such as the esophagus, thoracic duct and components of the peripheral nervous system.

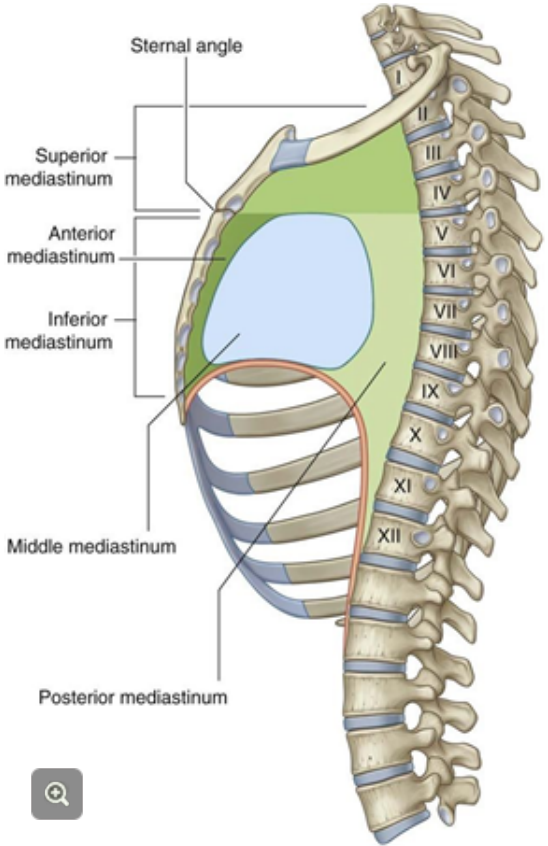




The **superior mediastinum** is separated from the **inferior mediastinum** by a transverse plane extending from the **sternal angle**, anteriorly, to the **intervertebral disc between the T4 and T5 vertebrae**.

The inferior mediastinum is subdivided further into the:

- **anterior mediastinum**, between the sternum and the pericardial sac
- **middle mediastinum**, which consists of the pericardial sac and contents
- **posterior mediastinum** between the pericardial sac and vertebrae T5 - T12

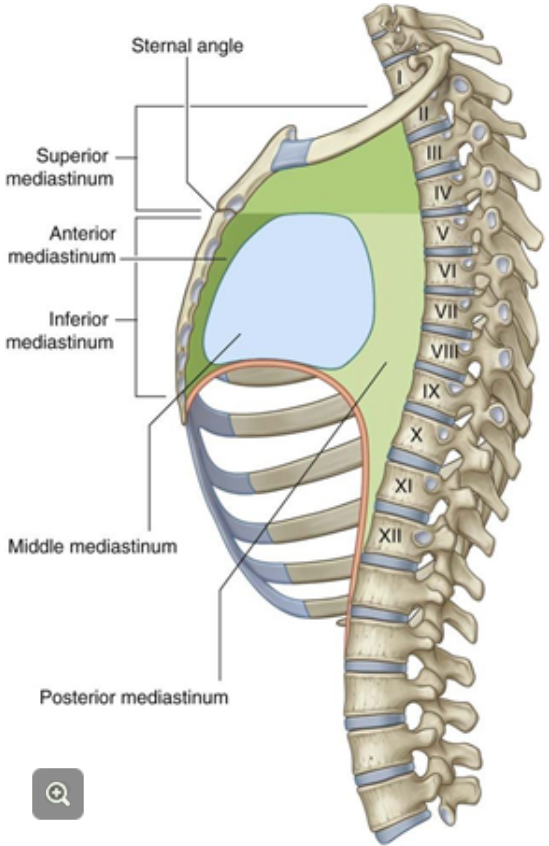


The **superior mediastinum** lies posterior to the manubrium and anterior to the T1 - T4 vertebrae.

It is limited, superiorly, by an oblique plane enclosing the superior thoracic aperture.

It is limited, inferiorly, by a horizontal plane passing through the sternal angle and the intervertebral disc between the T4 and T5 vertebrae.

Above, the superior mediastinum is continuous with the neck and below it is continuous with the inferior mediastinum.

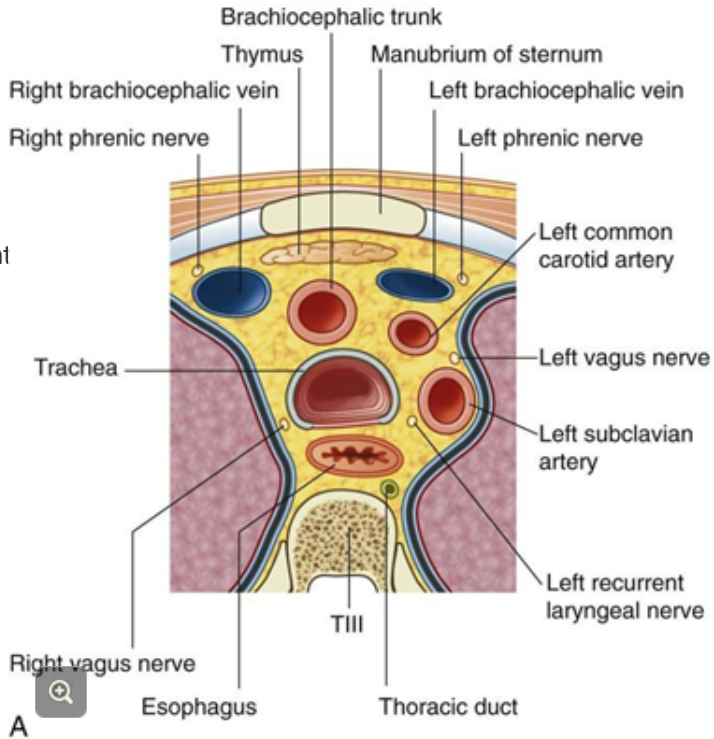


Take note, in the accompanying figure, that the superior mediastinum is **bordered, laterally, by the right and left mediastinal parietal pleura**.

In studying the superior mediastinum, one will encounter, from anterior to posterior, the

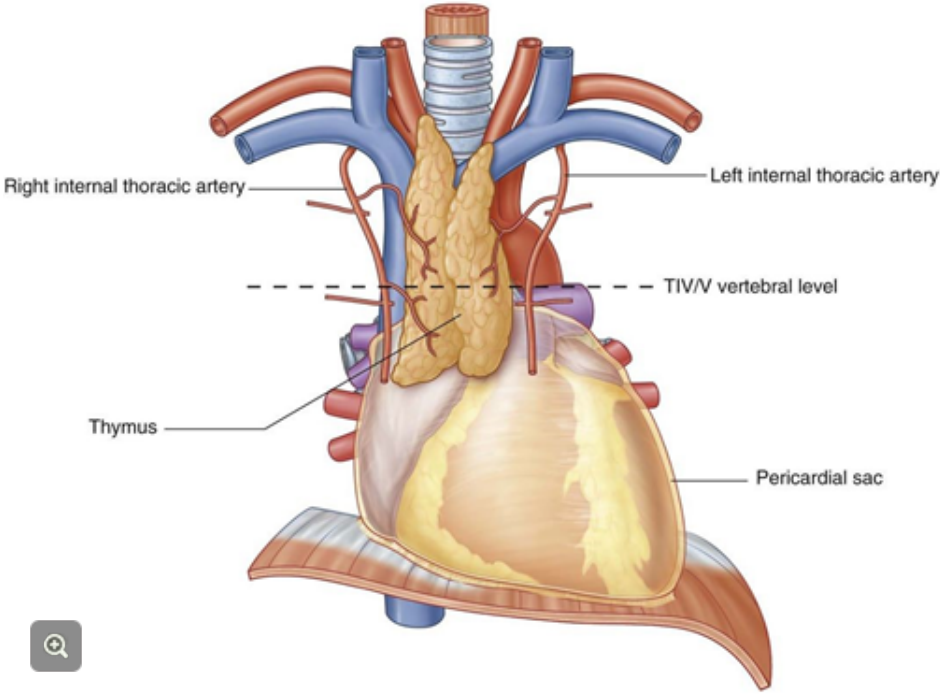
- thymus, or its remnants
- phrenic nerves
- superior vena cava and its tributaries, the right and left brachiocephalic veins
- arch of the aorta and its three branches
- trachea
- vagus nerves
- recurrent laryngeal branch of the left vagus nerve
- esophagus
- thoracic duct

Some find it helpful to remember that behind the **thymus** is a **venous plane** (SVC and tributaries), followed by an **arterial plane** (arch of aorta and branches), followed by **wind** (trachea), **water** (esophagus) and **lymph** (thoracic duct).



The **thymus** lies in the superior mediastinum immediately posterior to the manubrium of the sternum and extends, inferiorly, into the anterior mediastinum where it lies posterior to the body of the sternum. It is an irregularly shaped, bilobed structure.

While the thymus is a significant structure in the child, during which time it is involved in the development of the immune system, it **atrophies progressively after puberty**. In the elderly adult, it can be difficult to discern from surrounding adipose tissue.



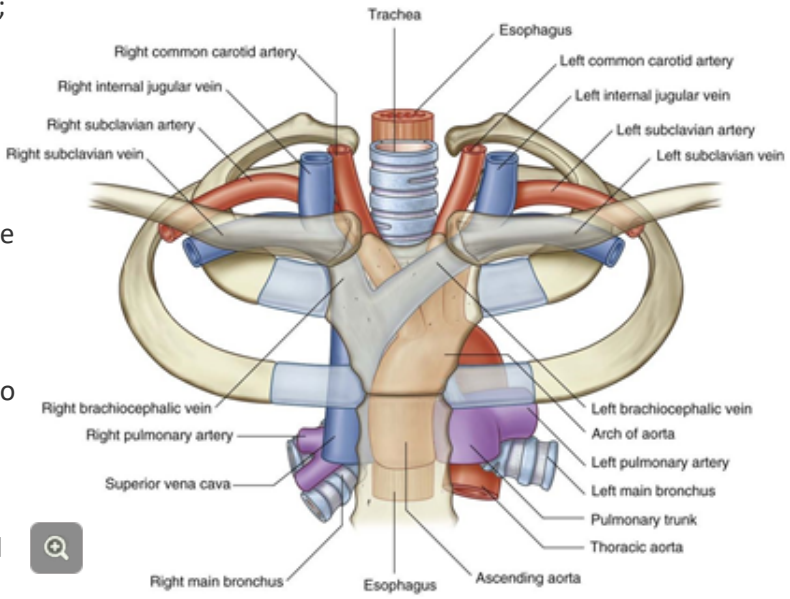
Recall that the **venous plane** of the superior mediastinum lies behind the thymus and consists of the **superior vena cava** (SVC) and its tributaries, the **left and right brachiocephalic veins**. Recall that the brachiocephalic veins form on each side by the union of the **internal jugular and subclavian veins**.

The brachiocephalic veins are **asymmetrical** because the **SVC is a right-sided structure**; notice in the accompanying figure that the SVC lies posterior to the right side of the manubrium and sternum.

Because of this, **the left brachiocephalic vein is longer**; it crosses the midline posterior to the manubrium to unite with the right brachiocephalic vein adjacent to the right first costal cartilage.

The SVC extends vertically from the first to the third costal cartilage where it opens into the right atrium. Its inferior portion, being contained within the pericardial sac, is therefore in the middle mediastinum.

Immediately before entering the pericardial sac, and **at the level of the sternal angle**, the SVC receives the azygous vein .



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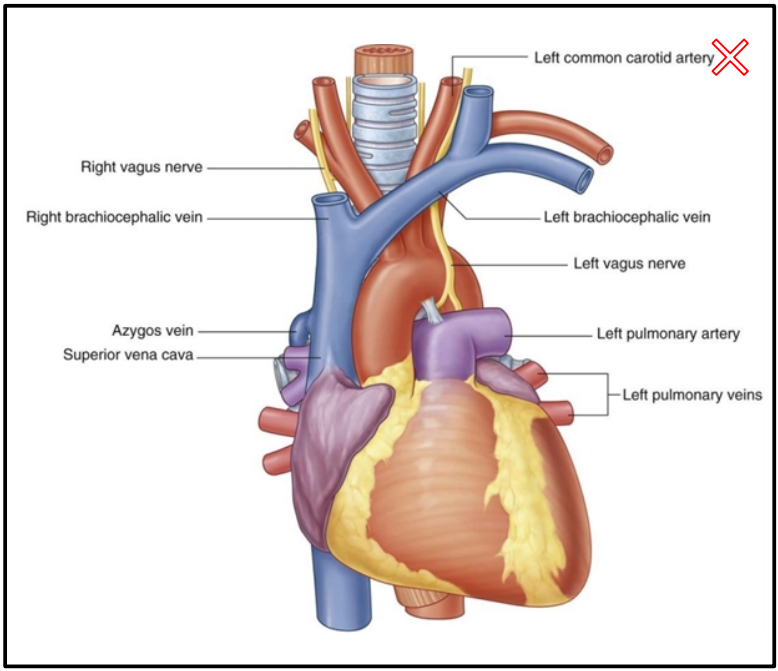
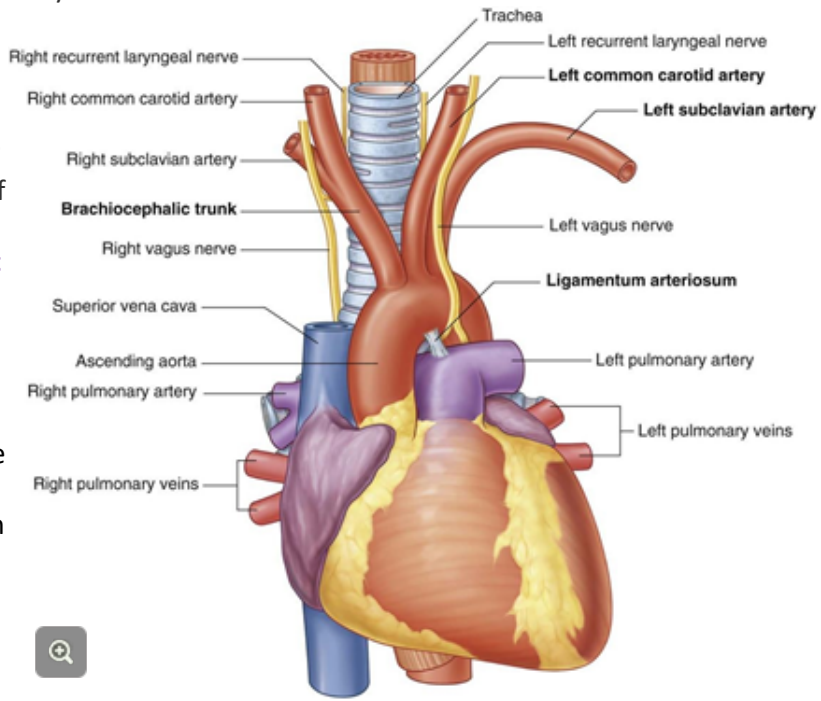


In the thorax, the aorta is subdivided into the **ascending aorta**, **arch of the aorta**, and **thoracic (descending) aorta**. The **arch of the aorta begins and ends at the level of the sternal angle** and so lies wholly within the superior mediastinum. It arches from **right to left** and from **front to back**. It passes to the left of the trachea and over the left primary bronchus.

The arch of the aorta gives rise to three branches within the superior mediastinum, all of which are crossed anteriorly by the left brachiocephalic vein.

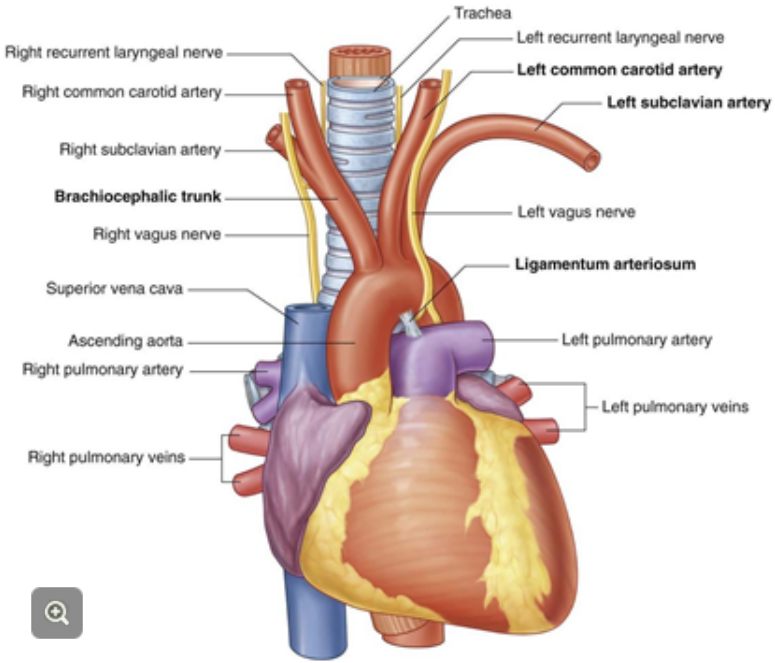
On the right, the first branch of the arch of the aorta is the **brachiocephalic trunk**; it is a short artery that divides into the **right common carotid artery** and the **right subclavian artery**.

When present, the **thyroid ima artery** commonly arises as a branch of the brachiocephalic trunk. It contributes to the blood supply of the thyroid gland. It is important to keep the thyroid ima artery in mind during head and neck surgeries, particularly during thyroidectomies, because if cut, it can be a source of significant bleeding.



The second and third branches of the arch of the aorta are the **left common carotid artery** and **left subclavian artery**. The common carotid arteries mainly supply the head and neck and the subclavian arteries supply the upper limbs.

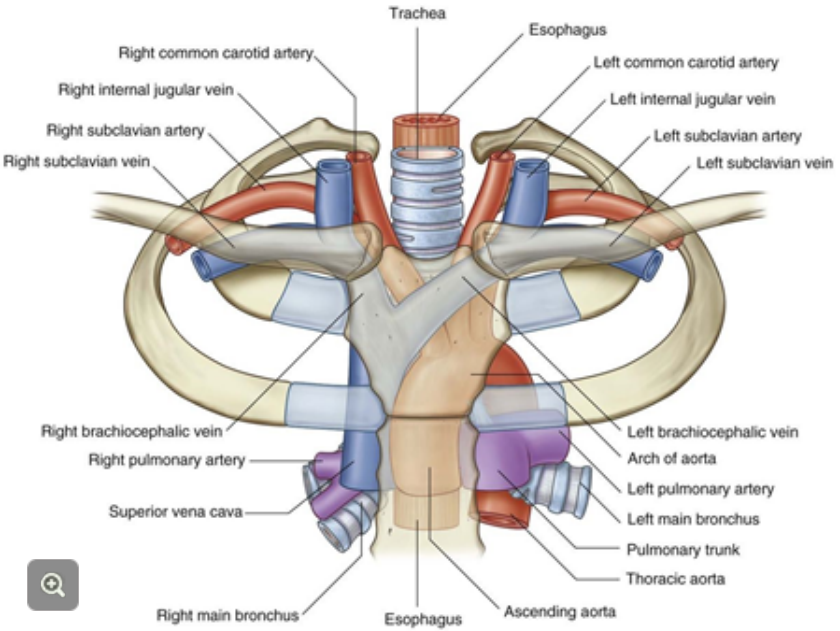
The **ligamentum arteriosum** is a remnant of the fetal **ductus arteriosus** which connected the pulmonary trunk to the arch of the aorta during development, thus allowing blood to bypass the non-functioning pulmonary circulation. The ductus arteriosus closes soon after birth and forms this ligamentous remnant.



The **trachea** is normally palpable in the midline as it enters the superior mediastinum at the **jugular notch**. The **esophagus** lies posterior to the trachea, **immediately anterior to the vertebral column**.

In the superior mediastinum, the trachea is posterior to the thymus gland, the left brachiocephalic vein and the brachiocephalic trunk. Related to the trachea and esophagus on the right is the azygos vein and on the left is the arch of the aorta.

At the level of the sternal angle, the trachea divides into the right and left main bronchi. The esophagus continues into the posterior mediastinum.



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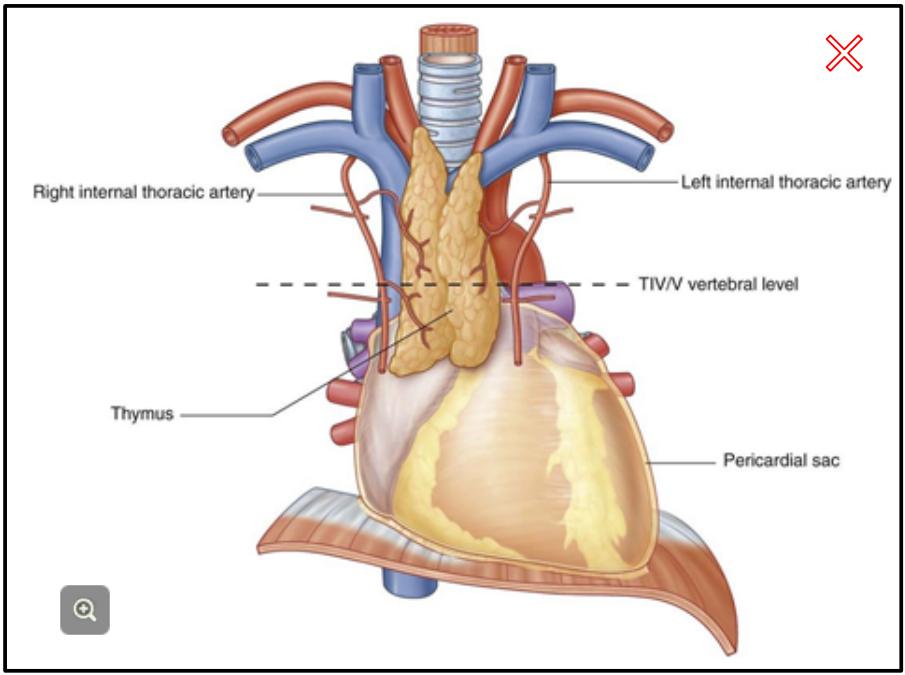

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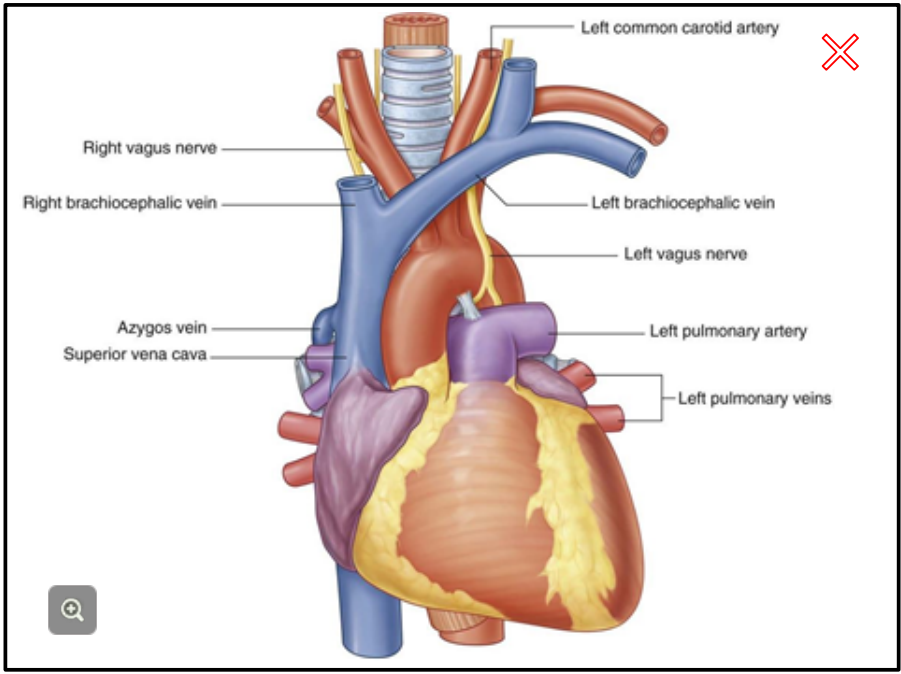

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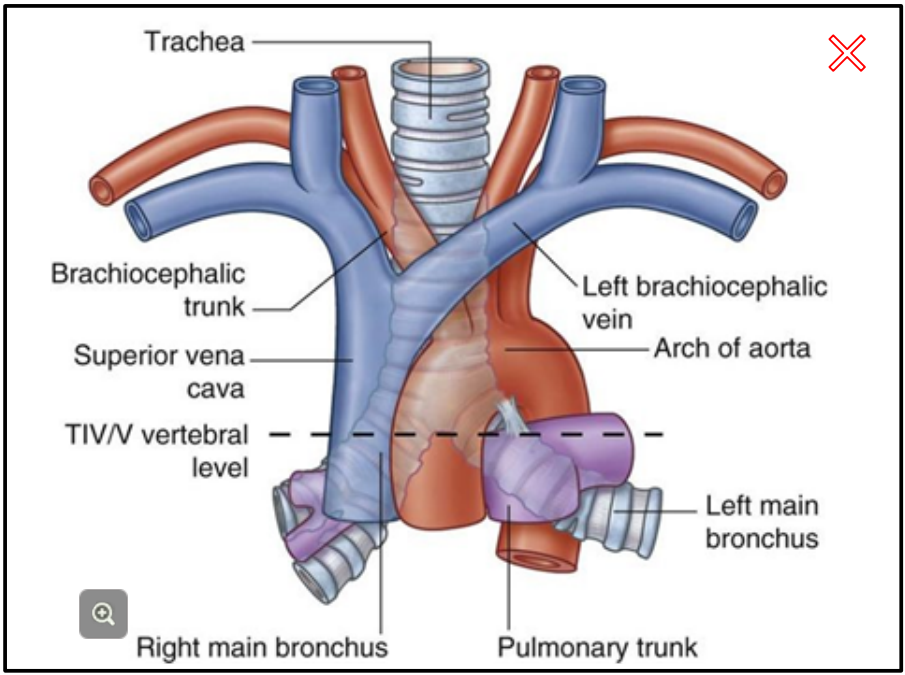
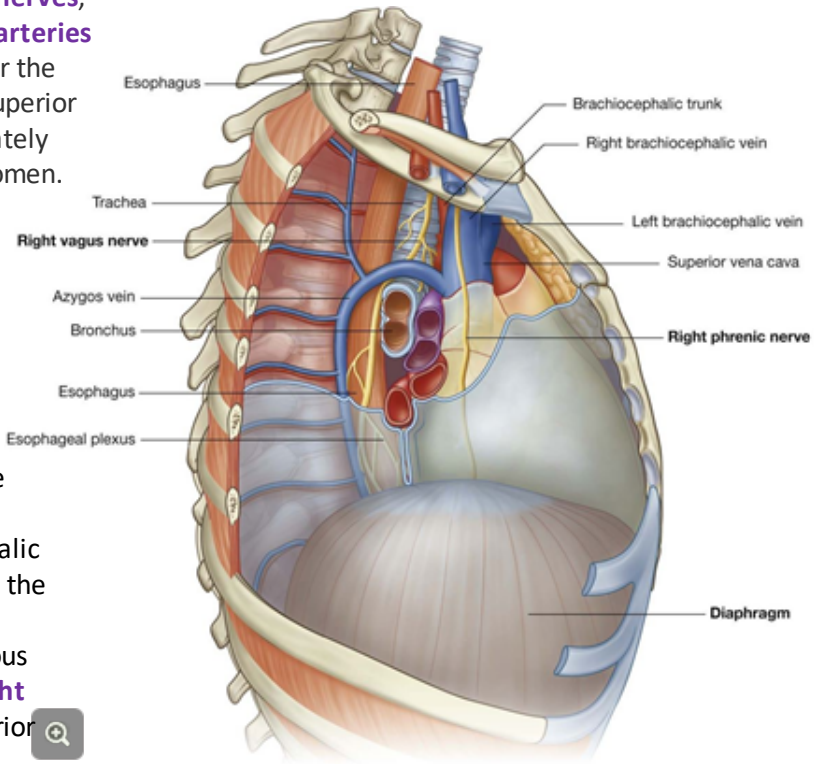


You will recall that in the neck the **vagus nerves**, CNs X, lie between the **common carotid arteries** and the **internal jugular veins**. They enter the superior thoracic aperture, traverse the superior and the posterior mediastinum and ultimately pass through the diaphragm into the abdomen. In the thorax they contribute **parasympathetic preganglionic fibres** to the **esophageal, cardiac and pulmonary plexuses**. They also transmit sensory information regarding **visceral function** back to the brainstem. They **do not transmit pain signals**.

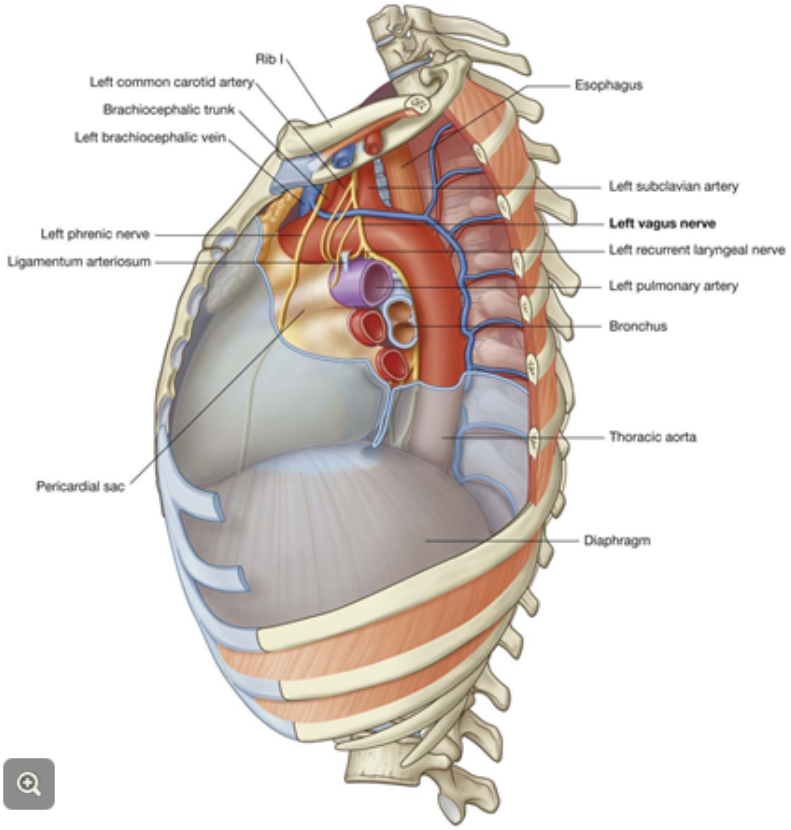
As it enters the superior mediastinum, the **right vagus nerve** lies between the right brachiocephalic vein and the brachiocephalic trunk. It descends on the lateral aspect of the trachea, deep to the mediastinal parietal pleura. It then passes medial to the azygous vein and **posterior to the root of the right lung** to reach the esophagus in the posterior mediastinum.



As it enters the superior mediastinum, the **left vagus nerve** lies posterior to the left brachiocephalic vein and between the left common carotid and left subclavian arteries. It descends lateral to the arch of the aorta just deep to the mediastinal parietal pleura. It reaches the esophagus in the posterior mediastinum by passing **posterior to the root of the left lung**.

The **left recurrent laryngeal nerve** arises from the left vagus nerve as it crosses the arch of the aorta. It recurs medially around the arch of the aorta lateral to the ligamentum arteriosum. It ascends the neck to the larynx in the groove between the trachea and esophagus.

You will recall that the **right recurrent laryngeal** nerve recurs around the right subclavian vein in the neck to similarly ascend to the larynx.

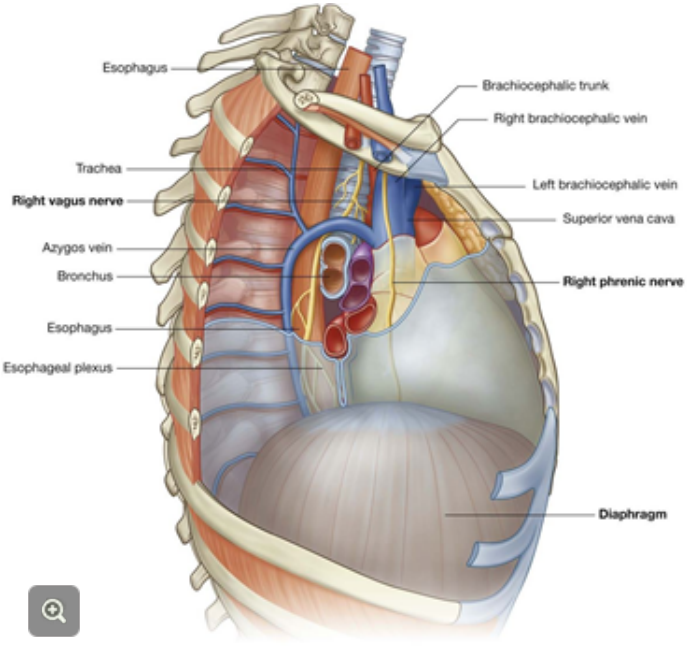


The **phrenic nerves** arise as a series of rootlets from the third, fourth and fifth cervical spinal cord segments. You will recall that the phrenic nerves descend in the neck on the anterior surface of the anterior scalene muscle. They then pass through the superior and middle mediastinum to supply motor and sensory innervation to the diaphragm and its associated membranes, the diaphragmatic parietal pleura and the diaphragmatic parietal peritoneum.

As they pass through the thorax, the phrenic nerves provide sensory innervation to adjacent tissues: the mediastinal parietal pleura, the fibrous pericardium, and the parietal layer of serous pericardium.

In the superior mediastinum, the **phrenic nerves** lie lateral to both the vagus nerves and brachiocephalic veins. The **right phrenic nerve** continues inferiorly along the right side of the superior vena cava. The **left phrenic nerve** continues inferiorly lateral to the arch of the aorta.

In the middle mediastinum, the phrenic nerves **pass anterior to the roots of the lungs** and descend lateral to the pericardial sac in the loose connective tissue between it and the mediastinal parietal pleura. In the thorax, the phrenic nerves are accompanied by the pericardiophrenic vessels.



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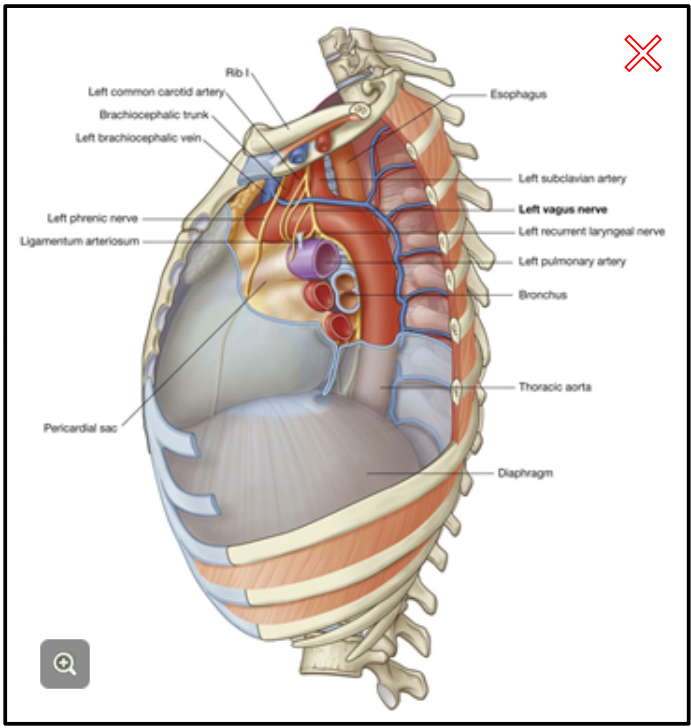
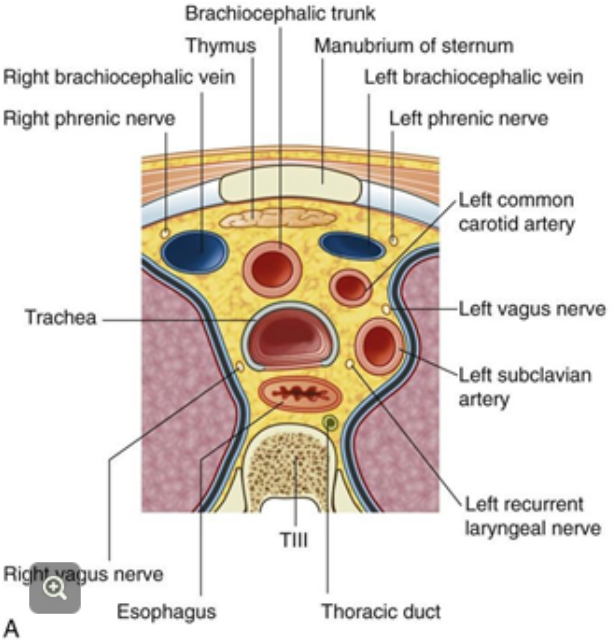
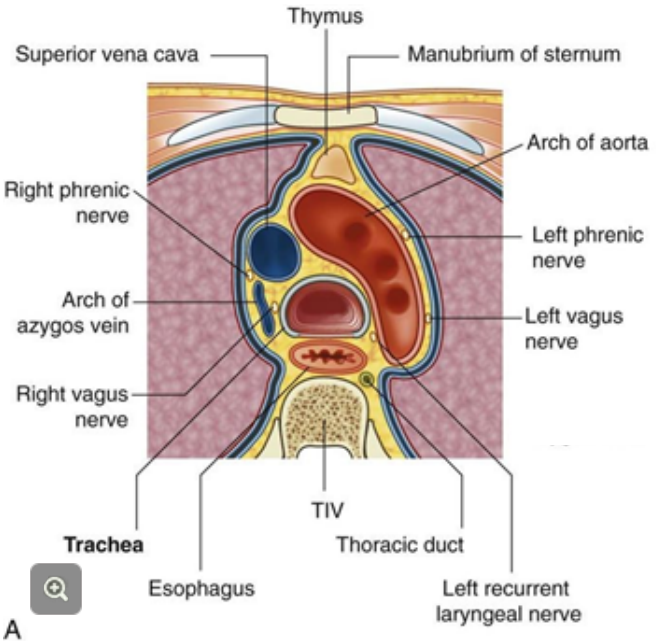




The **thoracic duct** is the largest lymphatic vessel in the body. It passes through the superior mediastinum to the left of the midline between the esophagus and the vertebral bodies. This is illustrated here at the T3 level (left) and the T4 level (right).



7A Prelab SLM

Part 2: Introduction to the Lower Limb

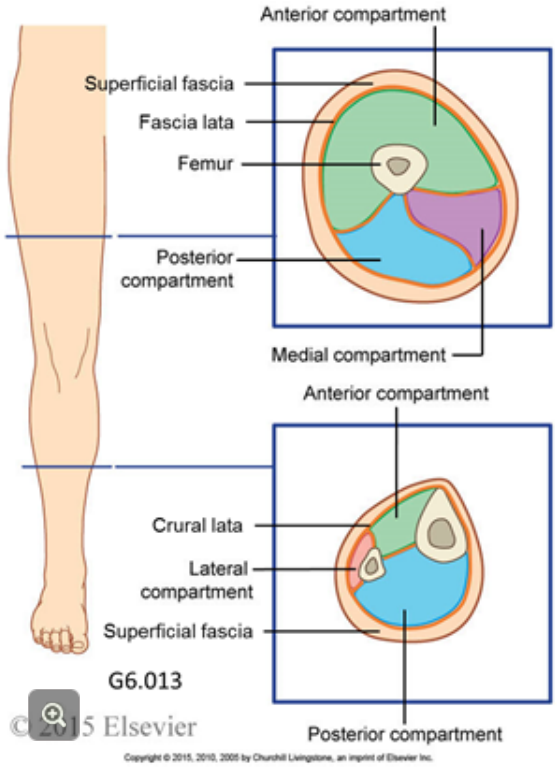
When you have learned the material presented in this exercise, you will be able to:

- describe the deep fascia of the lower limb
- fascial compartments of the lower limb
- superficial veins of the lower limb

Deep to the skin of the limbs is a layer of **superficial fascia** consisting of **loose connective tissue (CT)** and containing a variable amount of **adipose**. It is continuous with that covering the remainder of the body, such as **Camper's fascia** of the abdominal wall. This layer can also be called the **hypodermis**.

Below this superficial fascia is a **deep fascia** composed of **dense CT** that surrounds the musculature of the body. It is particularly robust in the limbs, where it forms **sleeve-like structures** that enclose muscles. In the lower limb it forms the **fascia lata** of the thigh and the **crural fascia** of the leg.

Septae extend from this enveloping fascia to the bones of the limb, creating **compartments** that contain groups of muscles, nerves, blood vessels and lymphatics. Because the deep fascia and septae are composed of inextensible dense CT, fluid accumulation within these compartments increases pressure, compressing their contents, including nerves and blood vessels. This can lead to **compartment syndromes**.



The muscles within a compartment have **common actions** and **nerve supplies**, as you will learn in Unit 5, next September. For now, focus on the fascia, fascial compartments and vasculature of the lower limb.

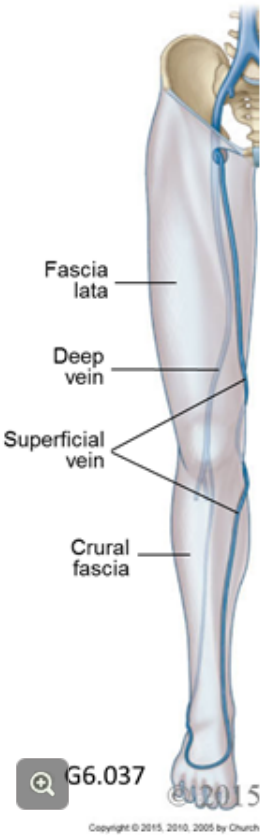
There are two sets of veins in the body, deep and superficial. **Deep veins accompany arteries**, usually with the same name. **Superficial veins** have **no accompanying arteries**. In the limbs, deep veins are located within the fascial compartments with the muscles, while **superficial veins** run in the **superficial fascia** of the limb. Shunting of blood between the two sets of veins functions in **temperature regulation; the greater the volume of blood in the superficial veins, the greater the heat loss, and vice versa.**

Superficial veins end by draining into **deep veins**. The deep veins then ultimately drain into either of the **venae cavae**, thus returning all systemic venous blood to the **right atrium**.

In the lower limb, superficial veins begin at the **dorsal venous arch**, which collects blood from the foot and drains it proximally. The dorsal venous arch continues laterally as the **small saphenous vein**, which passes **posterior to the lateral malleolus** and it continues medially as the **great saphenous vein**, which passes **anterior to the medial malleolus**.

The **small saphenous vein** continues in the **posterior midline** of the leg to the level of the **popliteal fossa**. At this level, the small saphenous vein passes through an opening in the deep fascia of the leg to **drain into the deep venous circulation by emptying into the popliteal vein**.

The **great saphenous vein** crosses the knee a **hands-breadth posterior to the medial border of the patella** (see image on base layer), and from there, it takes a relatively straight course toward the inguinal ligament.



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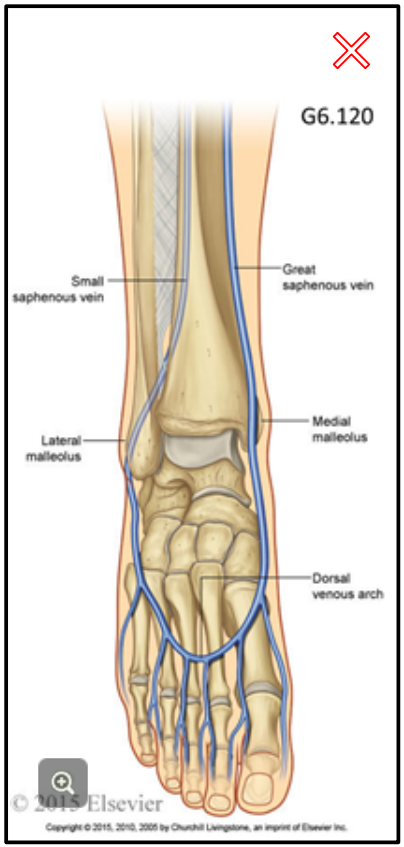
The **small saphenous vein** continues in the **posterior midline** of the leg to the level of the **popliteal fossa**. At this level, the small saphenous vein passes through an opening in the deep fascia of the leg to **drain into the deep venous circulation by emptying into the popliteal vein**.

The **great saphenous vein** crosses the knee a **hands-breadth posterior to the medial border of the patella** (see image on base layer), and from there, it takes a relatively straight course toward the inguinal ligament.



There are two sets of veins in the body, deep and superficial. **Deep veins accompany arteries**, usually with the same name. **Superficial veins** have **no accompanying arteries**. In the limbs, deep veins are located within the fascial compartments with the muscles, while **superficial veins** run in the **superficial fascia** of the limb. Shunting of blood between the two sets of veins functions in **temperature regulation; the greater the volume of blood in the superficial veins, the greater the heat loss, and vice versa.**

Superficial veins end by draining into **deep veins**. The deep veins then ultimately drain into either of the **venae cavae**, thus returning all systemic venous blood to the **right atrium**.

In the lower limb, superficial veins begin at the **dorsal venous arch**, which collects blood from the foot and drains it proximally. The dorsal venous arch continues laterally as the **small saphenous vein**, which passes **posterior to the lateral malleolus** and it continues medially as the **great saphenous vein**, which passes **anterior to the medial malleolus**.

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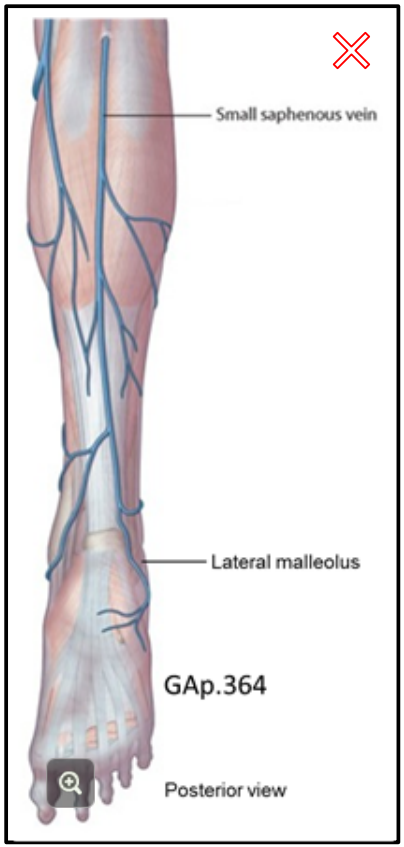


7.1 The Skeleton of the Lower Limb

What you'll need:

SPECIMENS

- Hanging skeleton
- Articulated lower limb
- Loose os coxa, femur, patella, tibia, fibula and articulated foot
- A model of the pelvis with viscera
- A 30 cm piece of string

When you have learned the material presented in this exercise, you will be able to recognize and describe the:

- bones of the pelvic girdle and their major features.
- bones of the lower limb and their major features.
- bones that meet to form the articulations of the lower limb.

The lower limb includes the **femur**, **patella**, **tibia**, **fibula**, and the bones of the foot, the **tarsals**, **metatarsals** and **phalanges**. The lower limbs are attached to the axial skeleton by the **pelvic girdle**, consisting of the **ossa coxae**.

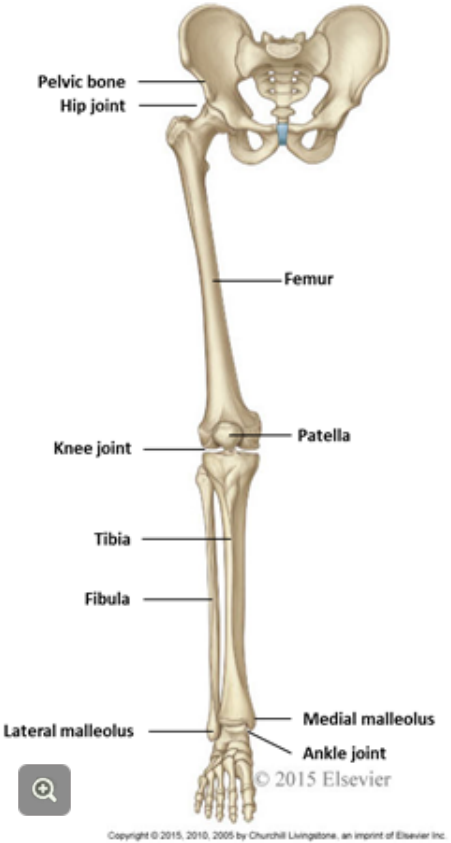
TASK

Start by IDENTIFYING

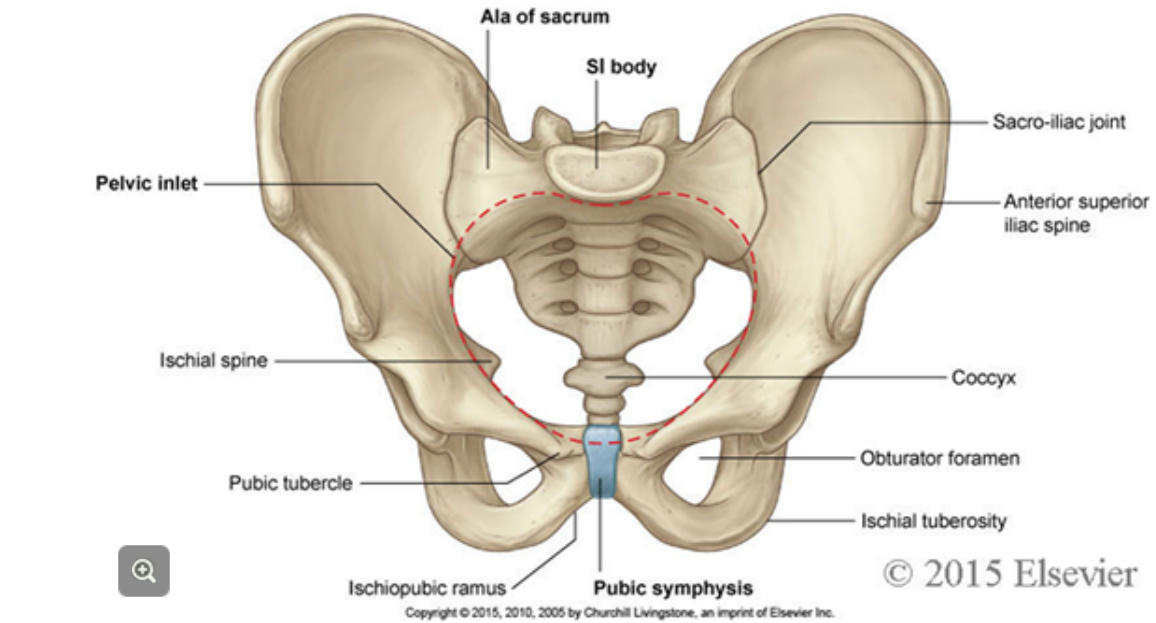
each of the following bones on
i) the articulated skeleton,
ii) the articulated lower limb and
iii) from amongst the individual bones with which you have been supplied.

Identify the bones articulating at the hip joint, the os coxa and the femur.

Identify the bones articulating at the knee joint, the femur, tibia and patella. Identify the bones articulating at the ankle joint, the tibia, fibula and talus.



The **pelvic girdle** attaches the lower limb to the axial skeleton. It consists of the two **ossa coxae**, or hip bones. The right and left hip bones articulate with each other anteriorly at the **pubic symphysis**, and with the sacrum, posteriorly, at their respective **sacroiliac joints**. When articulated with the sacrum and coccyx, components of the axial skeleton, the **pelvis** is formed. Portions of the following exercise regarding the os coxa is review from Lab 3.4, while other content is new.



TASK

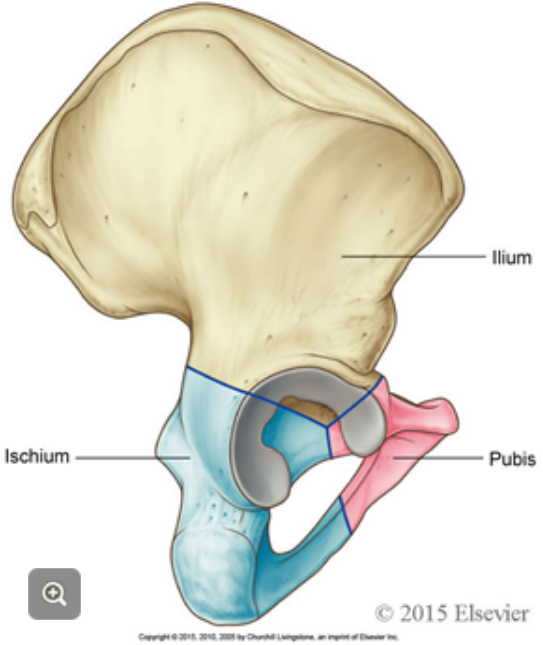
CHOOSE a disarticulated os coxa from amongst the bones with which you have been provided. It is an irregular bone, formed of three component parts, that fuse at around 16 years of age. **Identify the ilium, ischium and pubis.** The three come together to form the **acetabulum**, the socket that articulates with the head of the femur to form the **hip joint**.

Identify the acetabulum on the os coxa in your hand.

Next, identify the anterior superior iliac spine and pubic tubercle. When the os coxa is in anatomical position, these landmarks **are aligned in the coronal plane**.

HOLD the os coxa in your hand in its correct anatomical orientation. Look at the hip bone from its lateral aspect and notice that the ilium lies superior to the acetabulum, the ischium posteroinferior and the pubis anteroinferior.

Identify the obturator foramen and notice that it is formed by the union of the ischium and pubis. In life, the obturator foramen is almost completely closed over by the **obturator membrane**, with only a small opening, the **obturator canal**, left in its superior margin. **It is through the obturator canal that vessels and nerves pass between the pelvis and the medial thigh**.



TASK

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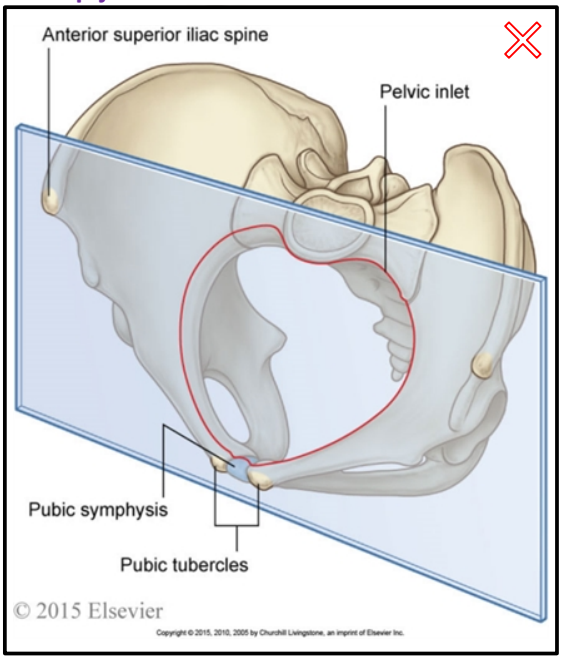
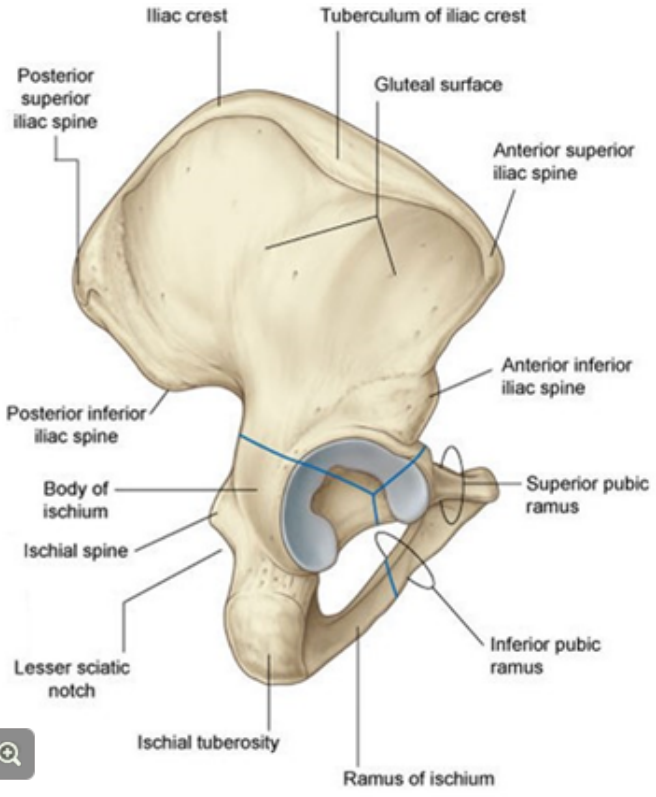


TASK

Start by IDENTIFYING the features of the ilium. Identify the anterior superior iliac spine (ASIS) and the posterior superior iliac spine (PSIS). Run your finger from the ASIS to the PSIS and you have outlined the iliac crest. The iliac crest is palpable along its entire length; you define your iliac crests with your index fingers and thumbs when you "put your hands on your hips".

Identify the anterior inferior iliac spine (AIIS) and the posterior inferior iliac spine (PIIS).

Identify the relatively flat lateral surface of the ilium, the gluteal surface.



TASK

IDENTIFY features of the ischium,

the ischial spine and ischial tuberosity.

Run your finger from the PIIS to the ischial spine, and you have defined the greater sciatic notch. Run your finger from the ischial spine to the ischial tuberosity and you have defined the lesser sciatic notch.

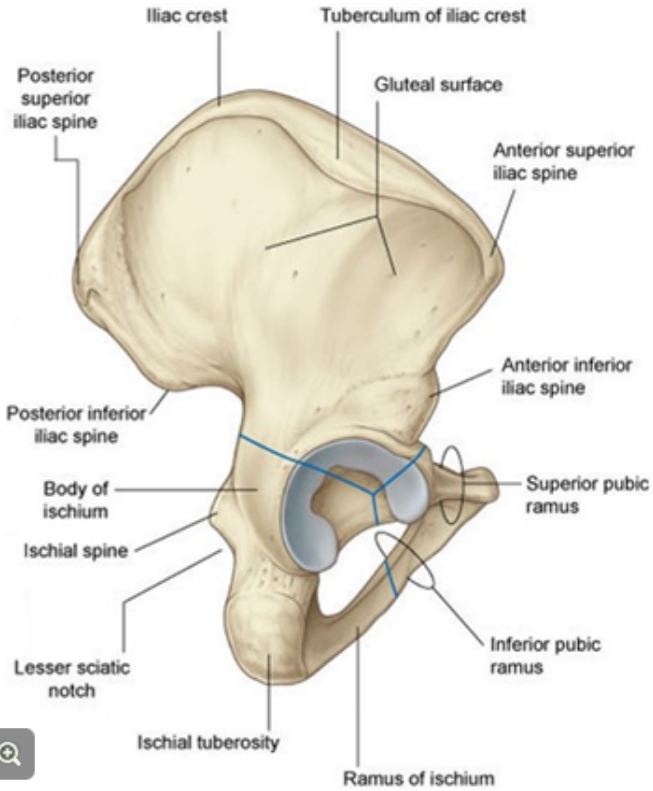
Lastly, identify the ramus of the ischium, reaching toward the pubis.

TASK

IDENTIFY the inferior pubic ramus

and the superior pubic ramus, meeting at the body of the pubis.

Notice that the ramus of the ischium meets the inferior pubic ramus to form the conjoint ramus. Notice again that the ischium and pubis together define the obturator foramen.



TASK

BEGIN again with the ilium.

From the medial aspect, again, identify the ASIS, PSIS and iliac crest. Identify the AIIS and PIIS.

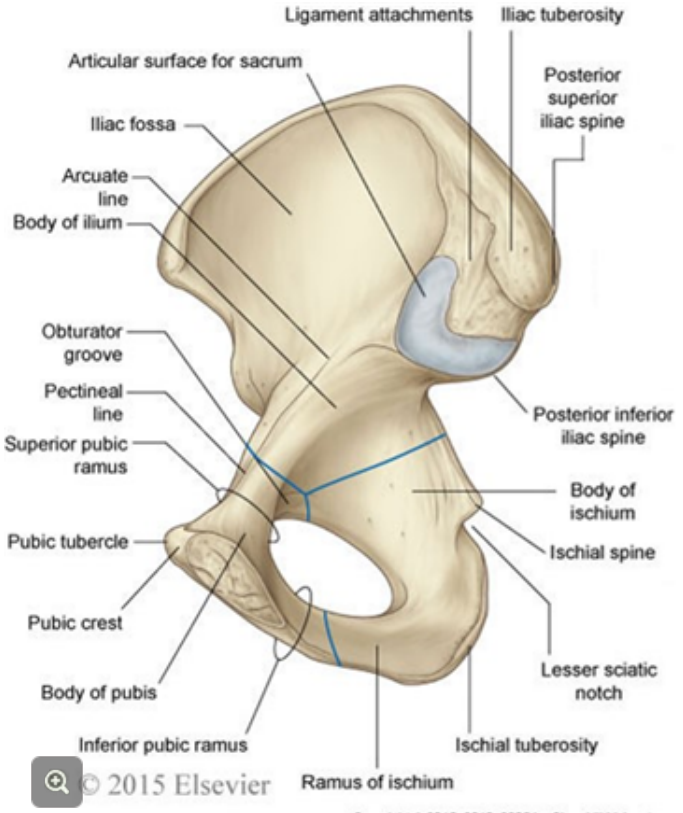
The gently concave medial surface of the blade of the ilium is called the iliac fossa. The iliac fossae form the shallow **false pelvis**. The ilium articulates with the sacrum at the sacroiliac joint.

Identify the smooth articular surface of the ilium, called the auricular surface.

TASK

From this aspect, IDENTIFY

the ischial spine and ischial tuberosity. Again run your finger from the PIIS to the ischial spine to define the greater sciatic notch and from the ischial spine to the ischial tuberosity to define the lesser sciatic notch.



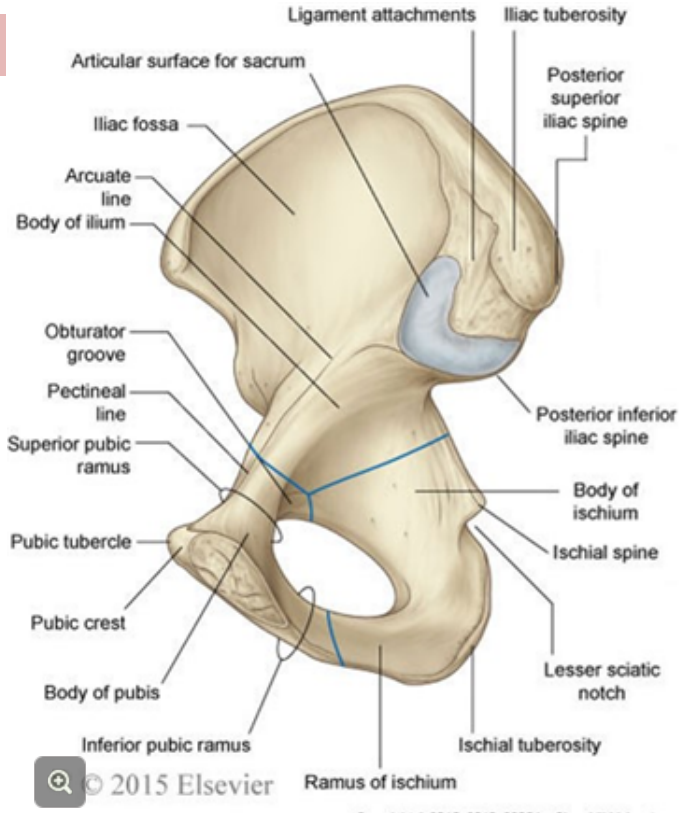
TASK

IDENTIFY the body of the pubis and its symphyseal surface, which articulates with its contralateral partner, via the pubic symphysis.

Identify the inferior pubic ramus articulating with the ramus of the ischium to form the conjoint ramus.

Identify the pubic crest, pubic tubercle and superior pubic ramus. The attachments of the inguinal ligament, you may recall, are from the ASIS to the pubic tubercle.

You've been provided with a piece of string. With it, connect the ASIS to the pubic tubercle and notice that a large curved gap is created between the string and the hip bone. It is through this space, deep to the inguinal ligament, that **major vessels and nerves pass between the pelvis and anterior thigh**.



Turn your attention to the model of the pelvis with viscera.

TASK

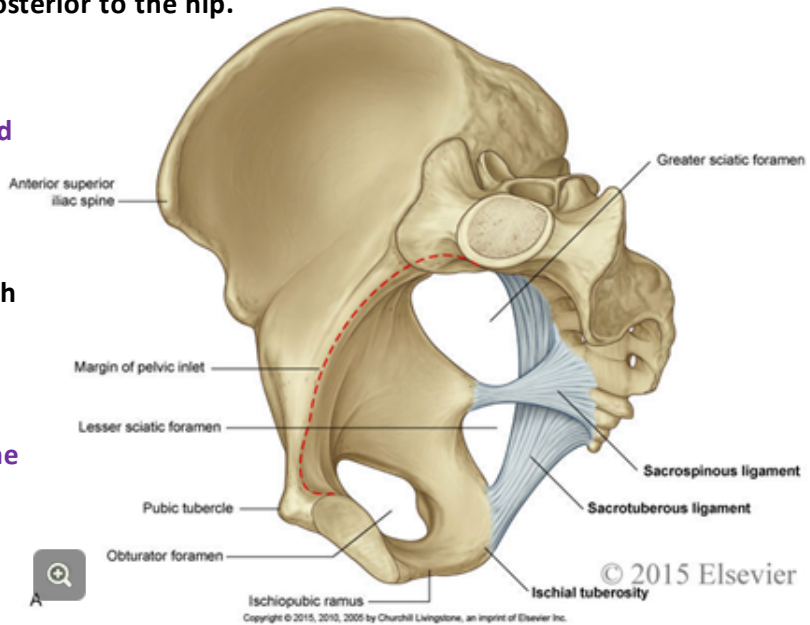
Identify the sacrotuberous and sacrospinous ligaments.

Demonstrate, by passing a probe through the opening, that the greater sciatic foramen opens from the pelvis to the gluteal region, posterior to the hip.

The greater sciatic foramen is a window through which vessels and nerves pass from the pelvis to the gluteal region and posterior thigh.

With a probe, demonstrate that the lesser sciatic foramen opens from the gluteal region to the perineum, which lies below the ischial spine.

The lesser sciatic foramen is a window through which vessels and nerves that have entered the gluteal region from the pelvis can then pass into the perineum.



Turn your attention to the model of the pelvis with viscera.

TASK

Identify the sacrotuberous and sacrospinous ligaments.

Demonstrate, by passing a probe through the opening, that the greater sciatic foramen opens from the pelvis to the gluteal region, posterior to the hip.

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With a probe, demonstrate that the lesser sciatic foramen opens from the gluteal region to the perineum, which lies below the ischial spine.

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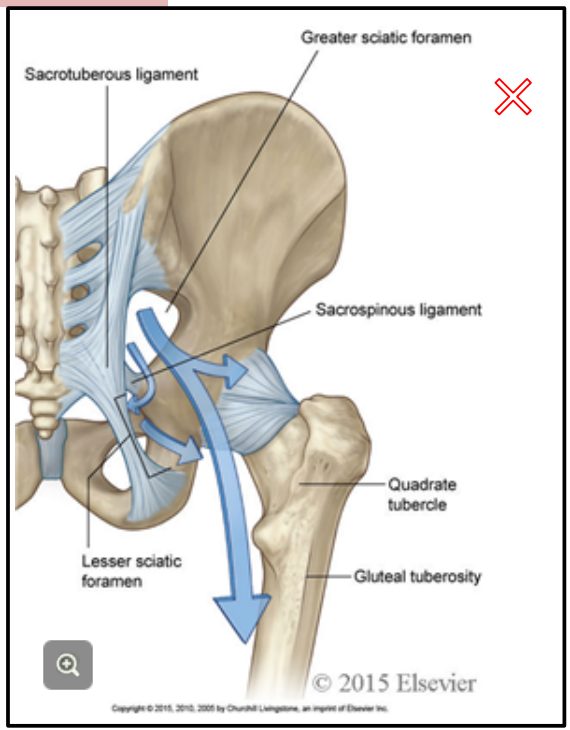
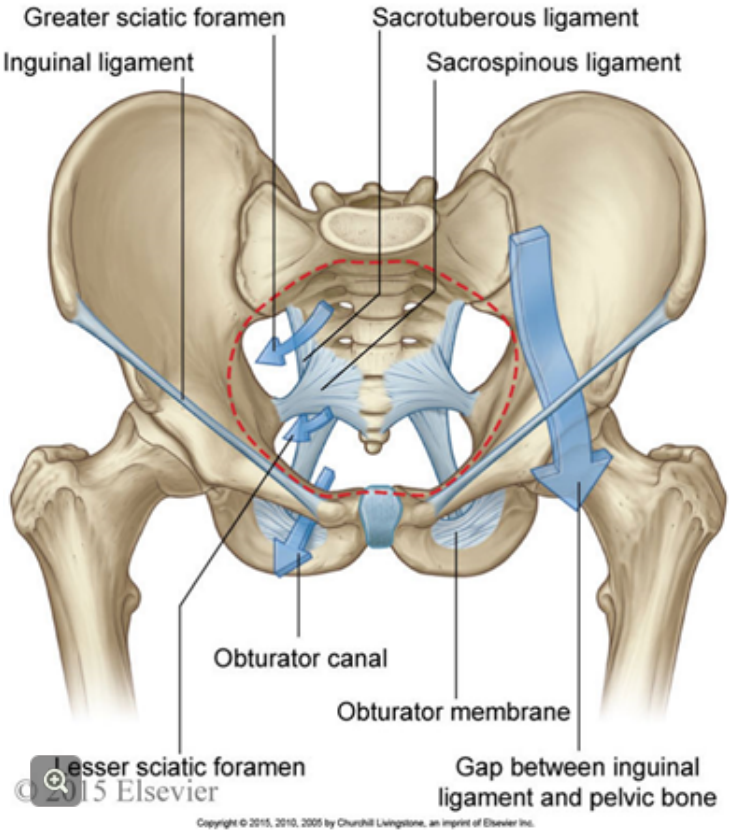


In summary, vessels and nerves pass in both directions, between the pelvis and the thigh through a variety of openings created when ligamentous structures join the bones of the pelvis.

- **The obturator canal joins the pelvis and the medial thigh.**
- **The gap between the inguinal ligament and the pelvic bone joins the pelvis and the anterior thigh.**
- **The greater sciatic foramen joins the pelvis and the gluteal region.**
- **The lesser sciatic foramen joins the gluteal region with the perineum.**



The femur is the longest bone of the body, making up roughly a quarter of your height.

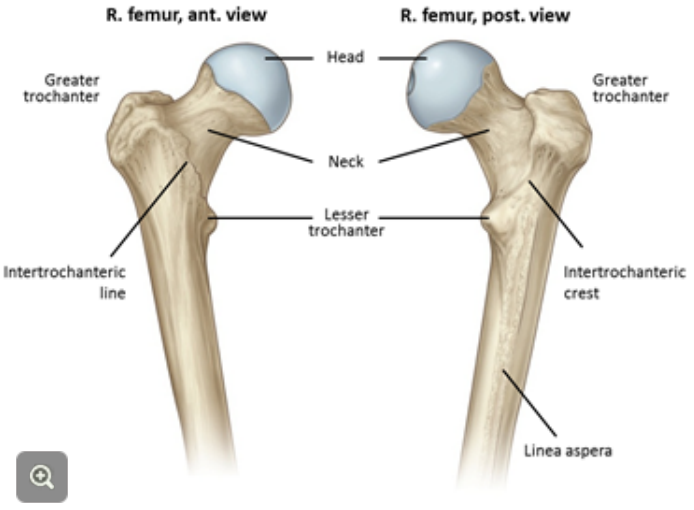
TASK

CHOOSE the femur

from amongst the bones with which you have been provided.

Begin by studying its proximal end. Identify its head, neck, and greater trochanter and lesser trochanter.

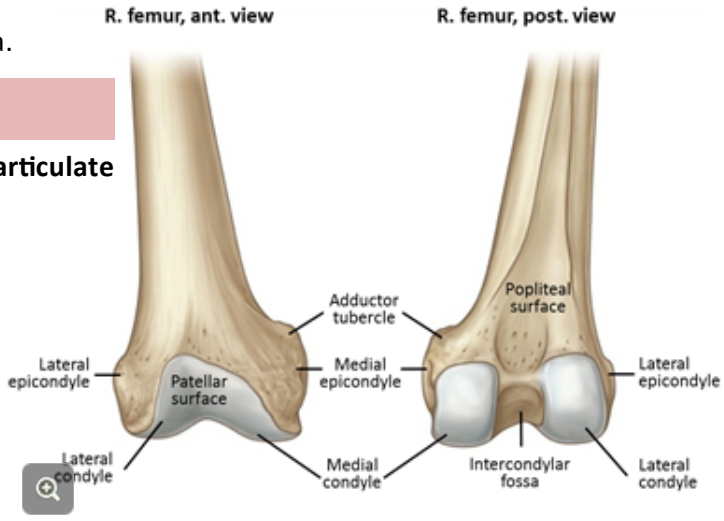
The head articulates with the acetabulum, and is therefore smooth and round. The neck is conical, with its base adjacent to the trochanters, and its apex carrying the head of the femur.



The greater and lesser trochanters are traction epiphyses, formed by deposition of bone tissue in response to the pull of strong muscles that attach at these points. **Observe that the greater and lesser trochanters are joined anteriorly by the intertrochanteric line, and posteriorly by the intertrochanteric crest.**

On the posterior aspect of the shaft of the femur, and running most of its length, identify a prominent ridge, the linea aspera. Again, these bony ridges are formed by deposition of bone in response to the traction applied by the attachment of powerful ligaments and muscles.

The distal end of the femur broadens to form its surface for articulation with the tibia and patella.



TASK

On its posterior surface, IDENTIFY:

the medial and lateral condyles, which articulate with the superior surface of the tibia.

Place your thumb into the deep fossa between the condyles, and you have identified the intercondylar fossa.

Superior to the condyles notice the triangular area between the diverging ends of the linea aspera. This is the popliteal surface of the femur.

Follow the condyles to the anterior aspect of the distal femur and notice that they meet as the patellar surface, which, not surprisingly, articulates with the patella.

Identify the medial and lateral epicondyles, to which stabilizing ligaments of the knee attach, and the adductor tubercle, to which a powerful adductor muscle of the thigh attaches. The adductor tubercle is a significant landmark in the passage of vessels between the thigh and the leg.

Since embarking on this exercise, you have **identified** the following structures and learned the **answers to the following questions**:

- What is the difference between the pelvis and the pelvic girdle? What three structures form the pelvic girdle? What four structures form the pelvis? Identify the articulations of the pelvis.
- Identify the features of the lateral and medial surfaces of the os coxa: the acetabulum, obturator foramen, ASIS, AIIS, PSIS, PIIS, iliac crest, gluteal surface, ischial spine, ischial tuberosity, greater and lesser sciatic notches, ramus of the ischium, inferior pubic ramus, superior pubic ramus, body of pubis, conjoint ramus.
- On the prosected os coxa with ligaments, identify the sacrotuberous and sacrospinous ligaments, and the greater and lesser sciatic foramen. Describe the body regions connected through each of these openings, through the obturator canal and inferior to the inguinal ligament.
- On the femur: identify its head, neck, greater and lesser trochanters, intertrochanteric line and crest, linea aspera, medial and lateral condyles, intercondylar fossa, popliteal and patellar surfaces, the medial and lateral epicondyles, adductor tubercle.
- What is a traction epiphysis?

Pause here to assess your learning. Quiz each other thoroughly. If you are satisfied with your **ability to identify these structures** and **answer these questions**, move on to the next stage of the exercise.

TASK

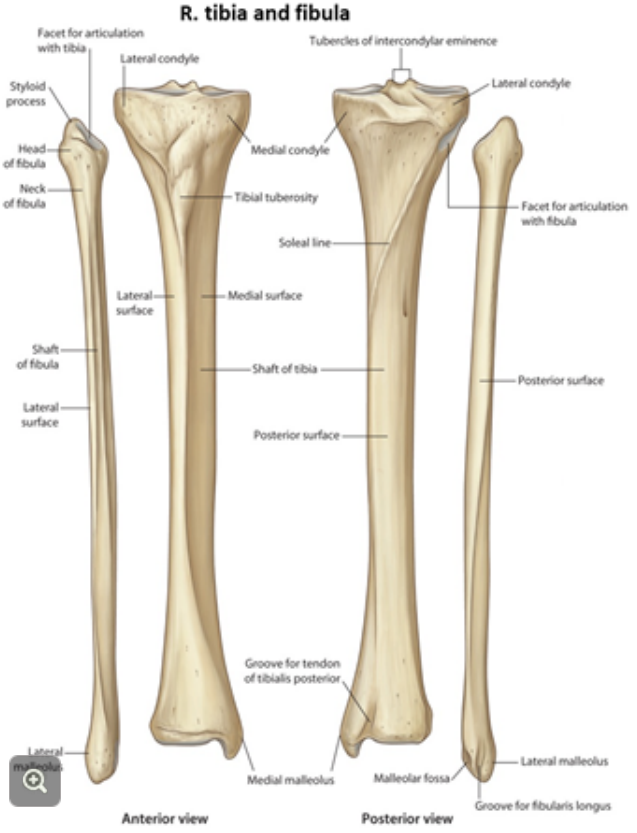
CHOOSE a tibia and fibula

from amongst the bones with which you've been provided.

Find the proximal end of the tibia, and start by identifying its superior surface, sometimes called the tibial plateau.

Identify the two articular surfaces of the tibial plateau, its medial and lateral facets, separated by the intercondylar eminence.

Articulate the femoral condyles with the medial and lateral facets of the tibia, and move the femur through flexion and extension. Observe how the articulating surfaces of the femur changes as it moves.

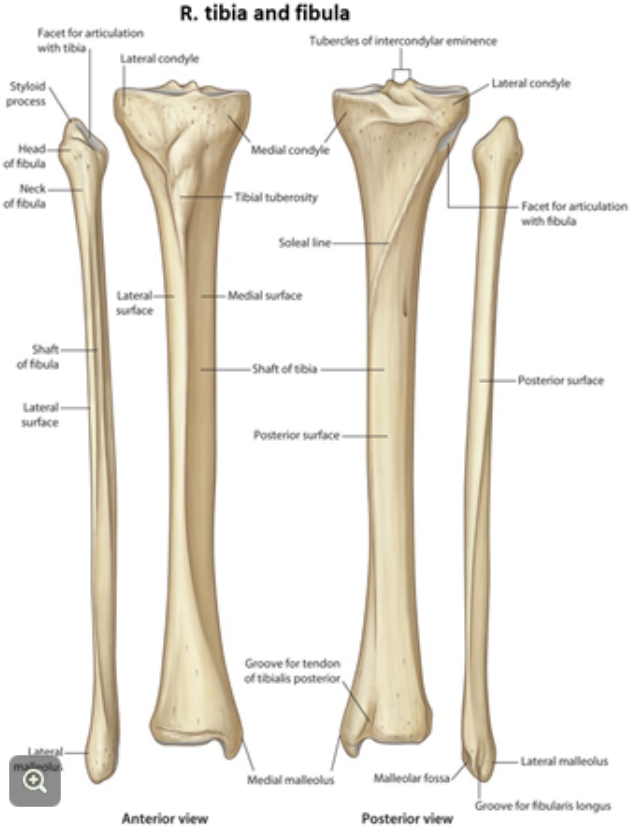


TASK

Identify the medial and lateral condyles of the tibia. These traction epiphyses are formed by strong ligaments that stabilize the medial and lateral aspects of the knee joint.

Identify the tibial tuberosity, another traction epiphysis formed by the attachment of the quadriceps femoris, a massive muscle of the anterior thigh.

Identify the head and neck of the fibula and articulate its head with its facet on the posterolateral aspect of the proximal tibia. These surfaces form the proximal tibiofibular joint.



TASK

Start by IDENTIFYING

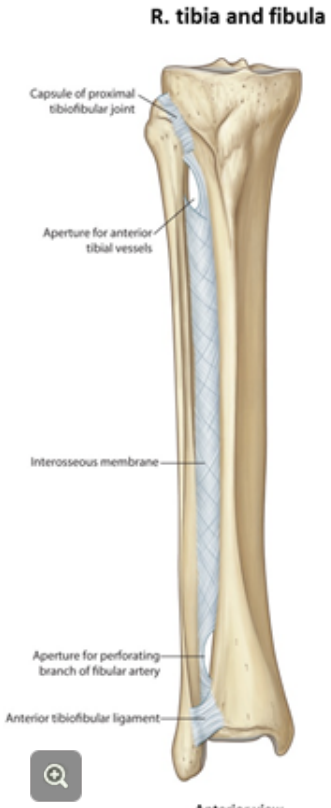
the inferior articular surface of the tibia.

Identify the medial malleolus, which extends distally from its medial aspect.

Identify the lateral malleolus, a feature of the distal fibula.

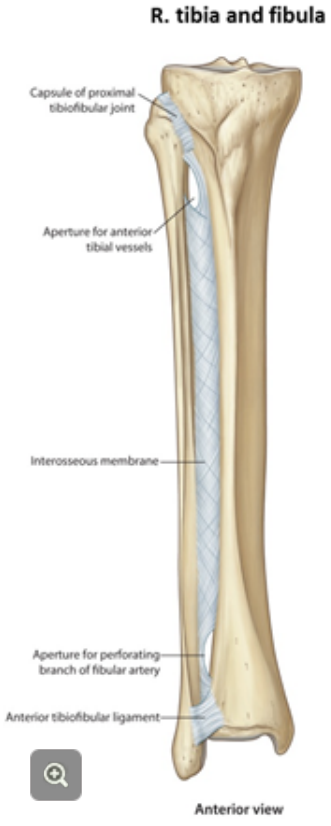
Again articulate the tibia and fibula and observe that their distal ends form a socket for articulation with the talus, the most proximal of the tarsal bones.

This second point of articulation between the tibia and fibula is the distal tibiofibular joint.



As you have observed, the tibia and fibula articulate at the **proximal** and **distal tibiofibular joints**. These bones are also joined along their lengths by a sheet of dense connective tissue called the **crural interosseous membrane**, which functions to increase surface area for muscular attachment

An opening in the proximal end of the crural interosseous membrane permits vessels to pass from behind the knee to the anterior aspect of the leg.



The bones of the foot are the tarsals, metatarsals and phalanges.
Perform the following exercise using the articulated bony foot provided.

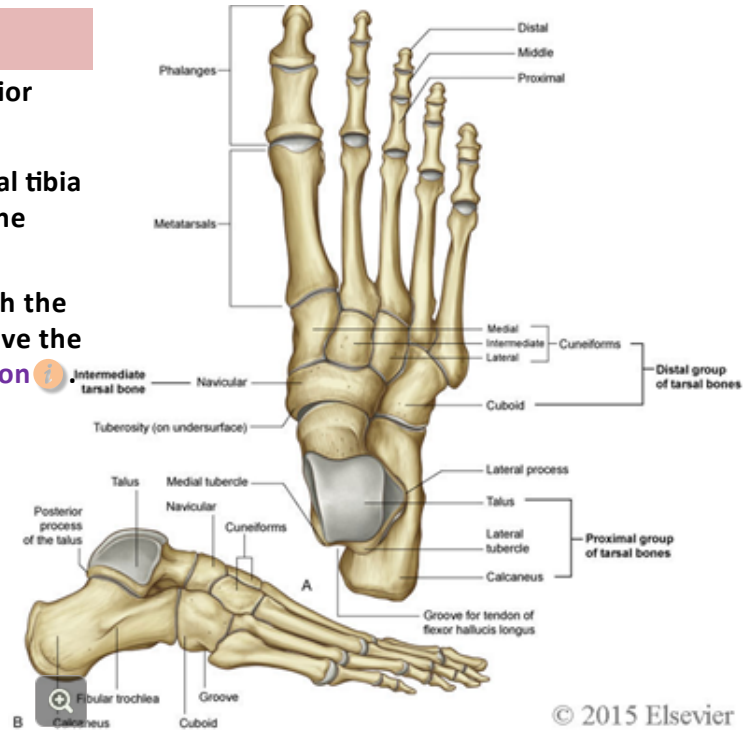
TASK

IDENTIFY the tarsal bones,

starting with the talus. Identify its superior surface, the trochlea of the talus, which articulates with the socket formed by the distal tibia and the medial and lateral malleoli, forming the talocrural joint.

Articulate the bony foot in your one hand with the joined tibia and fibula in your other hand. Move the bones through dorsiflexion and plantarflexion.

Identify the calcaneus, upon which the talus sits. Identify the subtalar joint, the articulation between these two bones. Identify the tuberosity of the calcaneous, its posterior extremity.



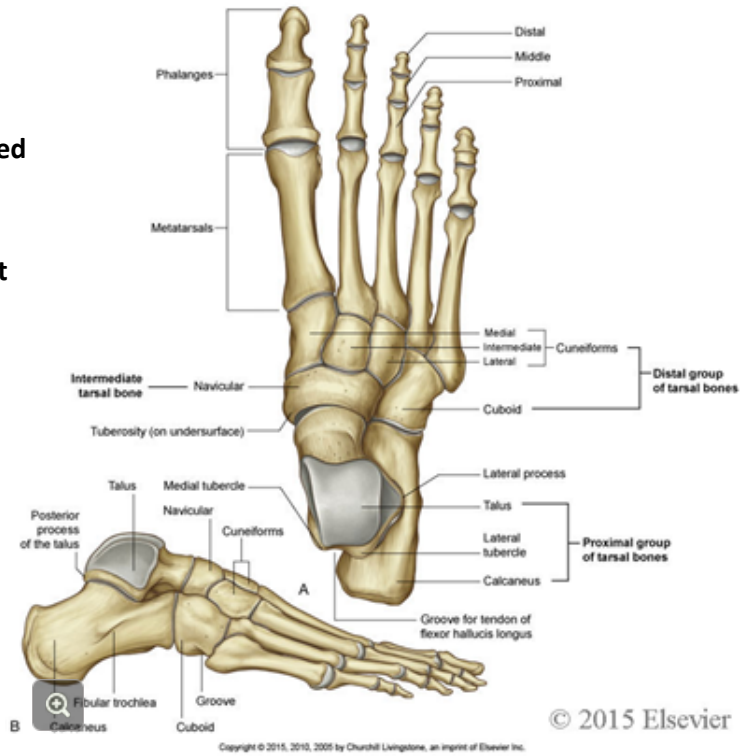
TASK

IDENTIFY the navicular and the cuboid, with which the talus and calcaneus articulate, distally.

Identify the calcaneocuboid joint and the talonavicular joint, which are together referred to as the transverse tarsal joint. Identify the location of the transverse tarsal joint.

It is at the transverse tarsal joint that the foot inverts and everts.

Confirm that the navicular articulates distally with three small bones, the medial, intermediate and lateral cuneiforms.

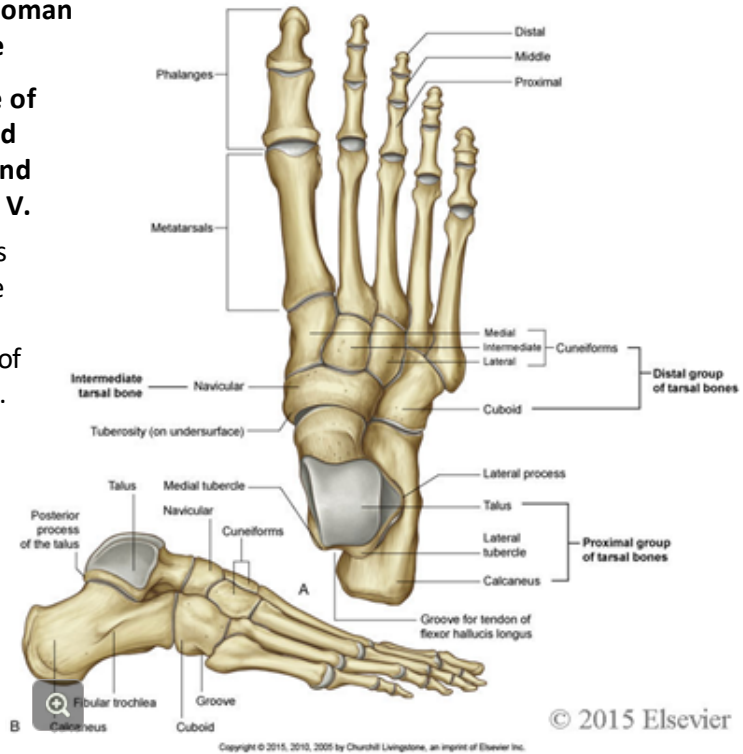


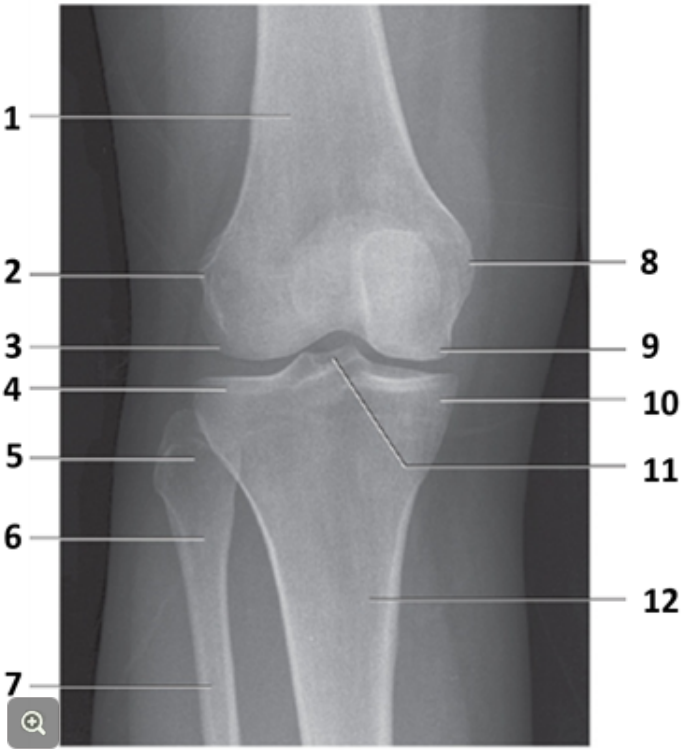
TASK

IDENTIFY the metatarsals, numbered from medial to lateral with Roman numerals, I - V. Observe that each of the three cuneiforms articulates distally with one of metatarsals I - III. Observe also that the cuboid articulates distally with both metatarsals IV and V. These are tarsometatarsal joints, I through V.

Identify the phalanges. There are 14 phalanges in each foot, two within the great toe, and three within each of digits II - V. The articulations between the metatarsals and the proximal row of phalanges are the **metatarsophalangeal joints**. **Identify the metatarsophalangeal joints.**

The articulations between the phalanges are the **interphalangeal joints**. The great toe has only one **interphalangeal joint**, while toes II - V have both a **proximal and distal interphalangeal joint**. **Identify the locations of these various interphalangeal joints.**

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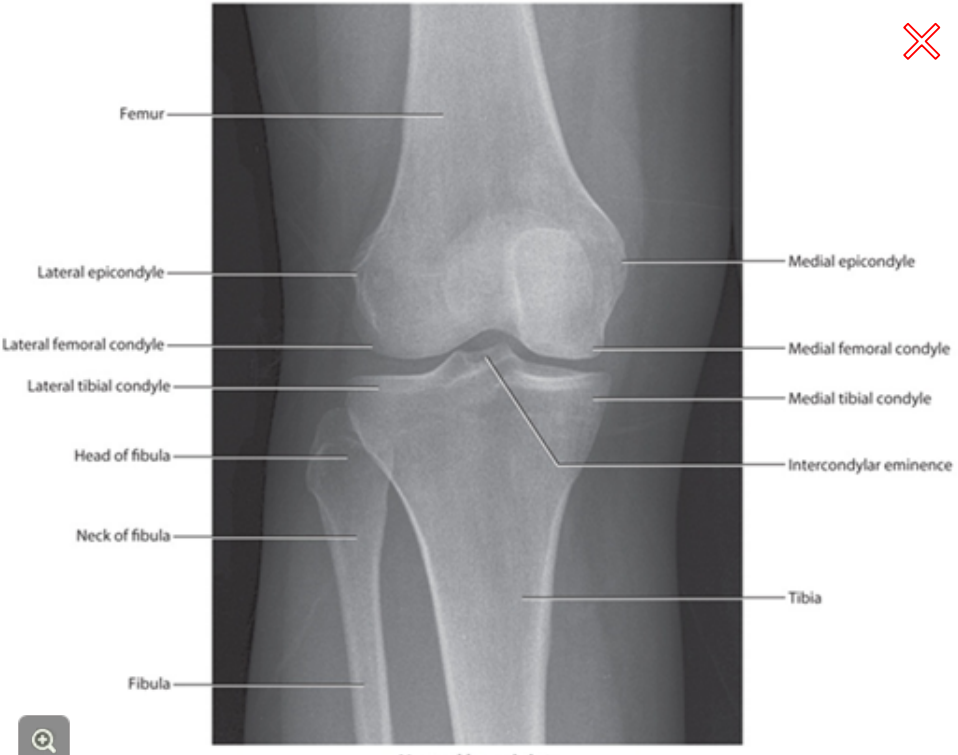
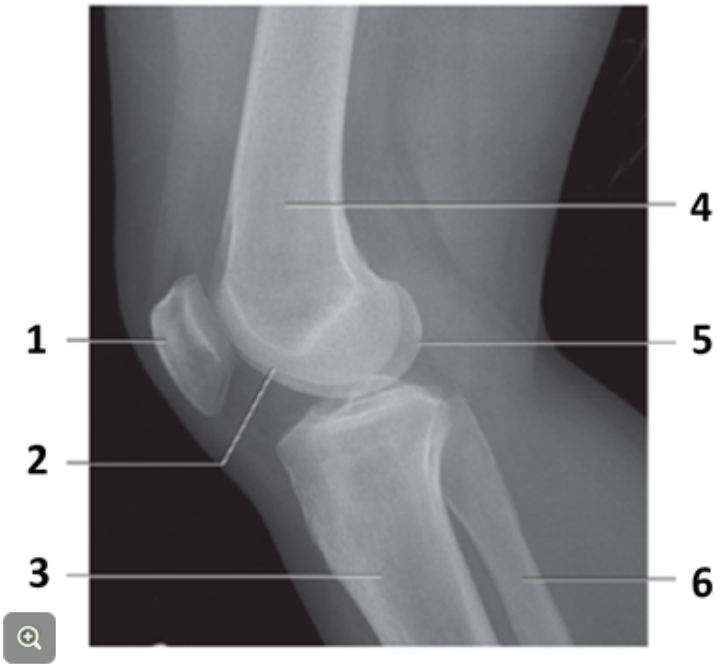


Normal knee joint.
Radiograph, AP view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Normal knee joint.
Radiograph, lateral view


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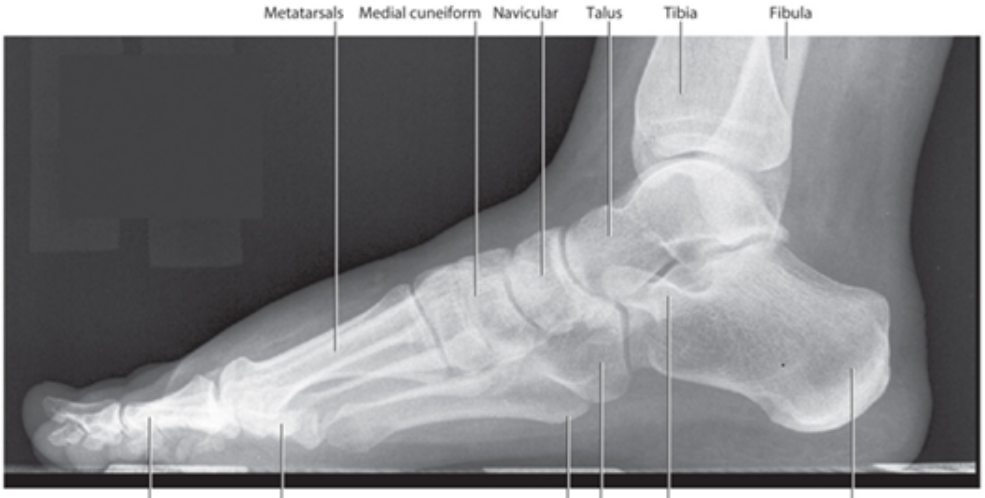
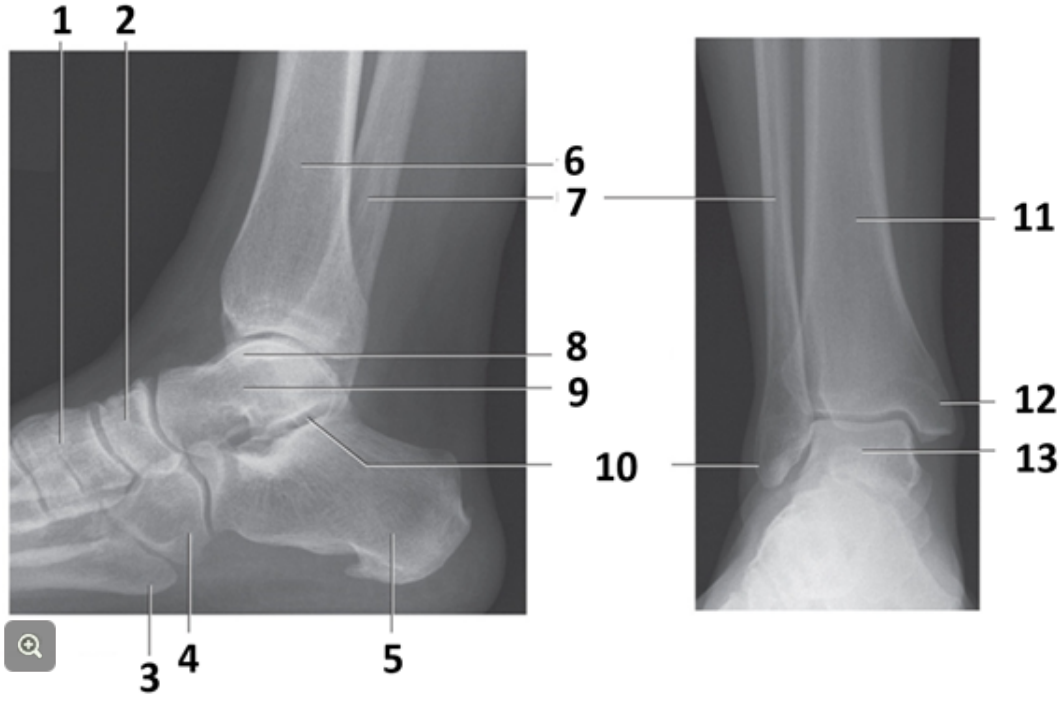


Foot bones.
Radiograph, lateral view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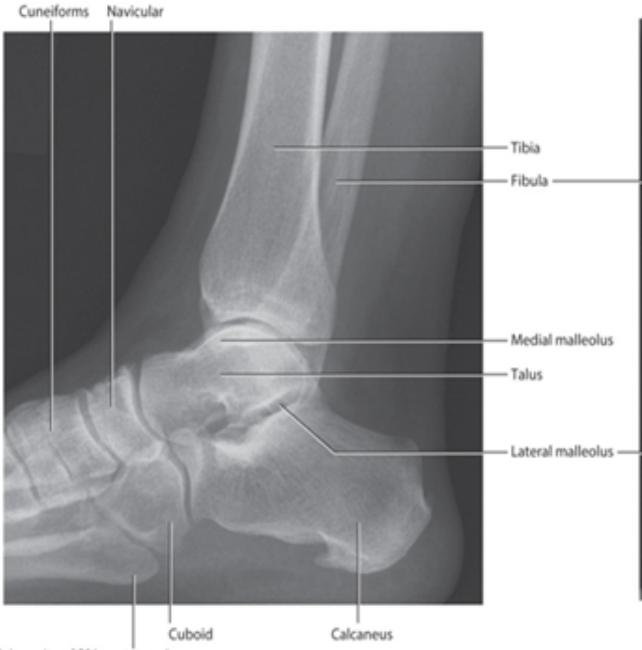


Normal ankle joint.
Radiograph, lateral view

Normal ankle joint.
Radiograph, AP view

Since the last Progress Check, you have **identified** the following structures and learned the **answers to the following questions**:

- Re. the tibia: the tibial plateau, its media and lateral facets (with what does each articulate?), intercondylar eminence, medial and lateral condyles, facet for articulation with fibular head, tibial tuberosity (what attaches here?), inferior articular surface, medial malleolus.
- Re. the fibula: head, neck, lateral malleolus.
- Identify the proximal and distal tibiofibular joints and describe the location of the crural interosseus membrane (function?).
- Re. the foot: talus, trochlea and head of talus, calcaneus, calcaneal tuberosity, navicular, cuboid, medial, intermediate and lateral cuneiforms, metatarsals I to V, proximal, intermediate and distal phalanges.
- Identify the bony surfaces that participate in the talocrural (what movements occur here?), subtalar, talonavicular, calcaneocuboid, transverse tarsal joint (what movements occur here?) tarsometatarsal joints I - V (name the bones that participate in each), metatarsophalangeal joints I - V, proximal and distal interphalangeal joints.
- Be able to identify all structures indicated on the radiographs provided.

If you are satisfied with your **ability to identify these structures** and **answer these questions**, call your TA over for confirmation and for **permission to move on** to the next exercise.

7.2 / 7.4 The Superior Mediastinum

What you'll need:

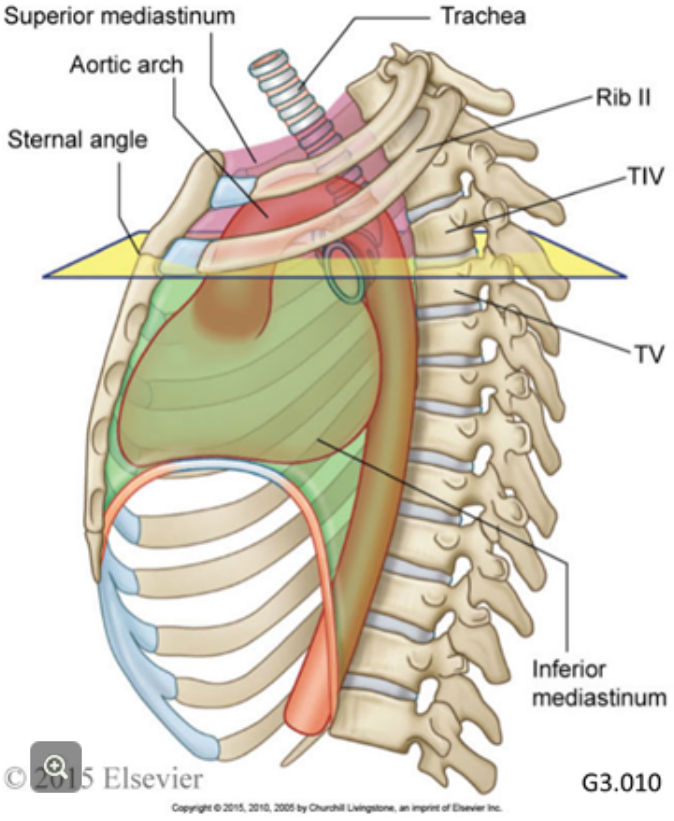
SPECIMENS

Pairs 2 will start on **Cadaver 1**. **Pairs 4** will start on **Cadaver 2**. One member of each pair will work on each side of the cadaver, as **both sides must be dissected**. Do what you can during your 90 minutes, working **slowly** and **methodically**, and then hand off the dissection to the next pair. Pairs 2 and 4 should get no further than slides 6 and 7, respectively by the end of 90 minutes.

Both clavicles have been cut laterally and disarticulated at the sternoclavicular joint, and so can be removed. The first ribs have been cut bilaterally. This leaves the **first ribs and manubrium attached only by soft tissue**. Using blunt dissection, you will detach this soft tissue and remove the manubrium and attached portions of ribs 1. This opens the superior thoracic aperture for the dissection of its contents.

When you have learned the material presented in this exercise, you will be able to recognize and/or describe the:

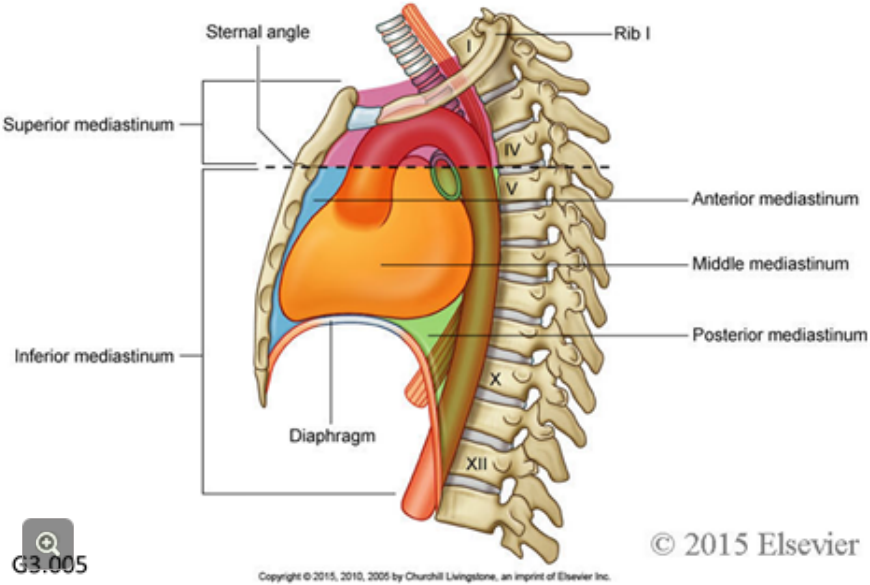
- relationships of the structures contained within the superior mediastinum.



In Lab 2.4 you learned that the thorax includes, in addition to the pleural cavities and their contents, an intermediate region called the **mediastinum**. It extends from the **superior thoracic aperture** to the **inferior thoracic aperture**, and from the **sternum**, anteriorly, to the **thoracic vertebrae**, posteriorly.

Remember the **superior thoracic aperture** is bordered by the T1 vertebral body, the first ribs and the superior border of the manubrium.

The **inferior thoracic aperture** is bordered by the xiphisternal joint, the costal margin, ribs 11 and 12, and the T12 vertebral body.



For the purpose of organizing our understanding of its contents, the mediastinum is subdivided into the **superior and inferior mediastinum**, separated by a horizontal plane passing through the **sternal angle** and the **disc between vertebrae T_4 and T_5**. The inferior mediastinum is further subdivided into the **anterior, middle and posterior mediastinum**

The superior mediastinum is a region of the thorax that **contains structures passing between the thorax and the neck, and between the thorax and the upper limb**.

The borders of the superior mediastinum are as follows:

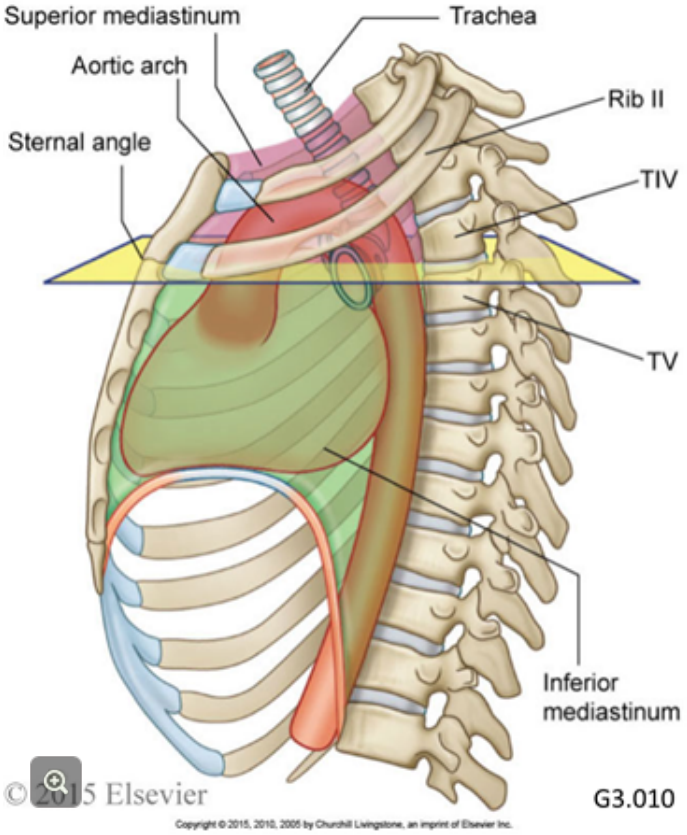
inferior: a horizontal plane passing through the **sternal angle** and the **disc between vertebrae T_4 and T_5**

superior: superior thoracic aperture (thoracic inlet)

anterior: manubrium of the sternum

posterior: bodies of vertebrae T_1 - T_4

lateral: left and right mediastinal pleura



TASK

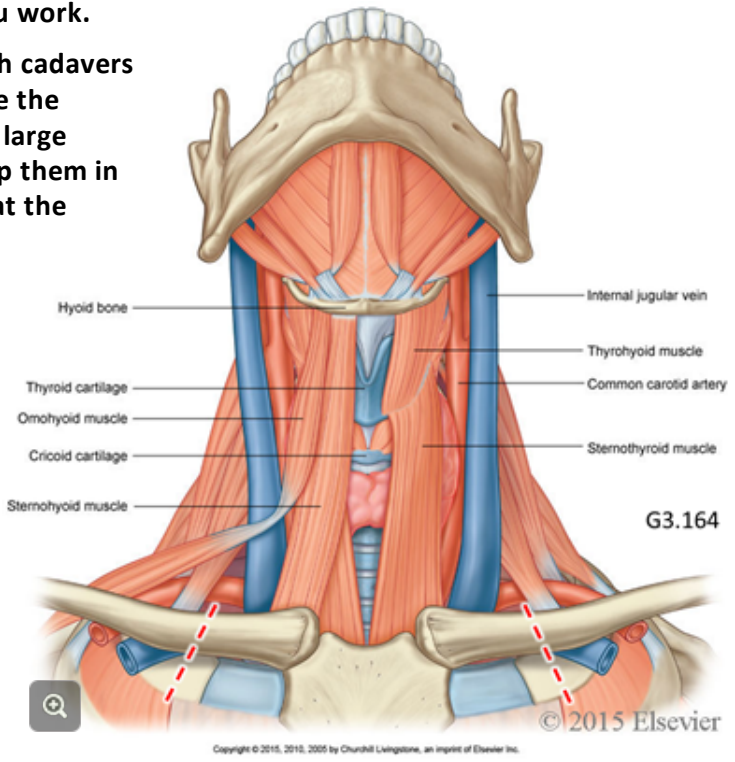
REMOVE the chest plate and clavicles

and wrap them in moist cloths while you work.

The lungs were to be removed from both cadavers during Lab 2. If the lungs are still intact, isolate the roots of the lungs and cut through them with large scissors. Once isolated, remove the lungs, wrap them in moist cloths and place them in the body bag at the foot of the cadaver.

IF YOU ARE WORKING ON CADAVER 1, identify any remaining attachments of the SCM, sternohyoid and sternothyroid muscles to the sternum. Using scissors, cut through their attachments to the manubrium and reflect them superiorly. As you work, identify the attachment of the anterior scalene muscle to the first rib.

Identify the phrenic nerve on the anterior surface of the anterior scalene. Cut the attachment of the anterior scalene to rib 1, but leave it in place. Leave the phrenic nerve intact.



The goal here is to remove the manubrium and the medial ends of the first ribs (remember, the ribs have been cut bilaterally for you), thus opening the superior mediastinum for dissection.

If you are working on cadaver 2, it might be best to start by cleaning the anterior and superior surfaces of the manubrium before going on to clean its posterior surface, as explained below.

TASK

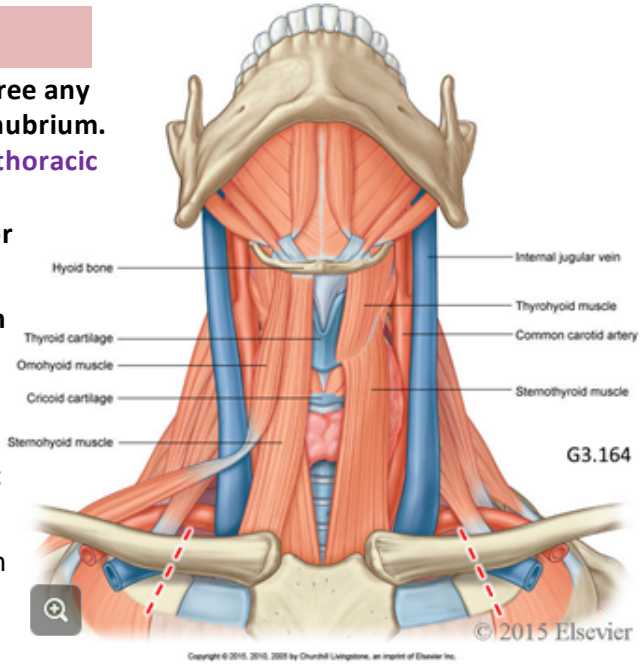
USING BLUNT DISSECTION

(your fingers, large, closed scissors, etc.) work free any CT attached to the posterior surface of the manubrium. Include with the CT the stumps of the internal thoracic artery and vein; that is, work carefully to leave the remnants of these vessels intact with the CT posterior to the manubrium.

Recall that the internal thoracic arteries branch from the subclavian arteries and the internal thoracic veins are tributaries of the brachiocephalic veins.

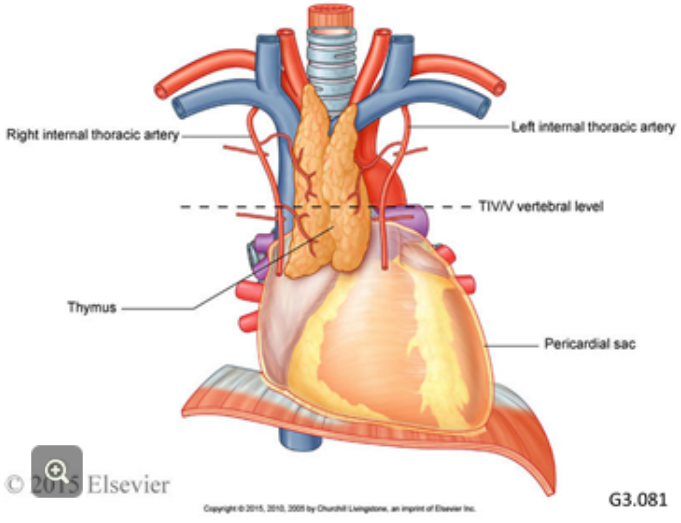
Once this is complete, remove the manubrium with the attached medial ends of the first ribs and wrap it up with the chest plate.

The contents of the superior mediastinum, embedded in connective tissue, are now exposed for further dissection.



As you know from your studies of immunology earlier in CPC-1, the thymus gland is a primary lymphatic organ responsible for the education of T-lymphocytes. This process primarily occurs during development and childhood, and the thymus decreases in size after puberty.

The thymus is located immediately posterior to the manubrium, and extends some distance inferiorly into the anterior mediastinum. Most of our body donors are elderly adults, and as such, their thymus will be small and difficult to distinguish from surrounding adipose and connective tissue. However, you might be able to identify it if you know what to look for: the thymus will be slightly pinker in colour as compared to the surrounding adipose tissue. Furthermore, the lobules of the thymus are smaller than those of the surrounding adipose. See if you can discern it.



TASK

REMOVE the thymus gland and surrounding adipose tissue using blunt dissection.

This will allow you to study the superior vena cava (SVC) and its tributaries.

TASK

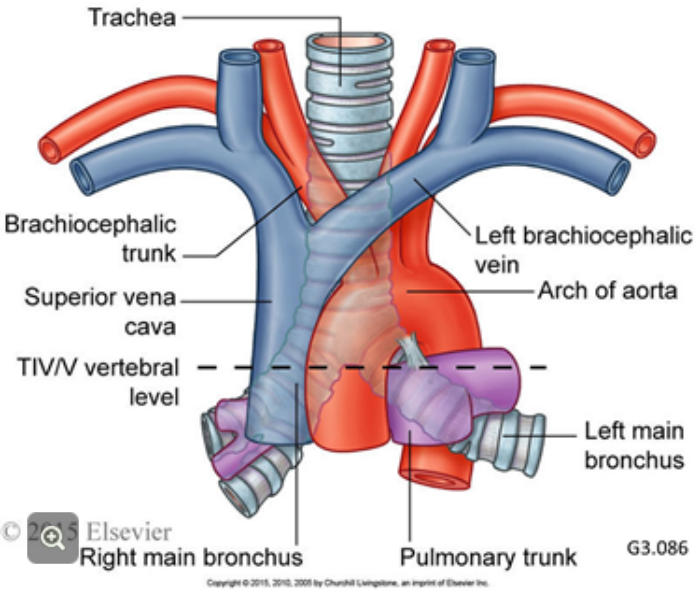
IDENTIFY THE SVC.

Notice that the SVC is located anterior to the root of the right lung.

Clean its anterior surface using blunt dissection and trace it superiorly, cleaning as you go, until it bifurcates into the right and left brachiocephalic veins. The internal thoracic veins drain into the brachiocephalic veins, bilaterally.

Identify and clean the stumps of the internal thoracic veins. Free the brachiocephalic veins from structures lying posterior to them, again using blunt dissection. Continue to clean the brachiocephalic veins until you clearly identify their bifurcation into the internal jugular vein and subclavian vein.

If you are working on Cadaver 1, the internal jugular veins will already be clean from your previous dissection of the neck.



TASK

IDENTIFY, through the parietal pleura on the right side of the mediastinum,

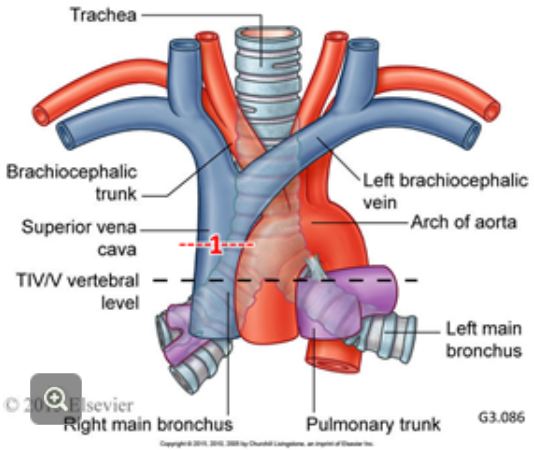
the azygous vein arching over the root of the right lung. Recall that the azygous vein drains blood from the posterior thoracic wall, bilaterally.

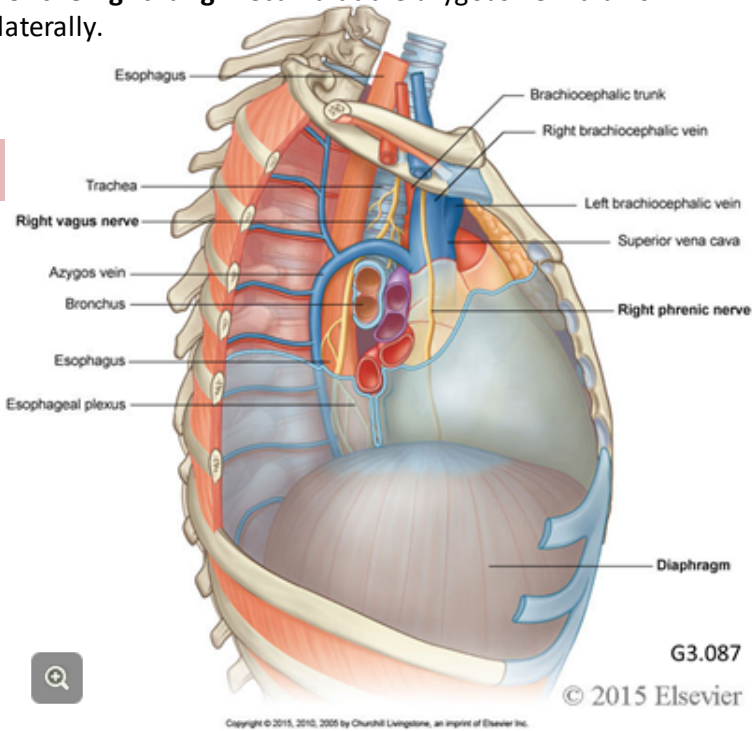
Observe that the azygous vein empties into the SVC at the level of the sternal angle.

TASK

USING LARGE BLUNT SCISSORS,

transect the SVC, just superior to the azygous vein (1).





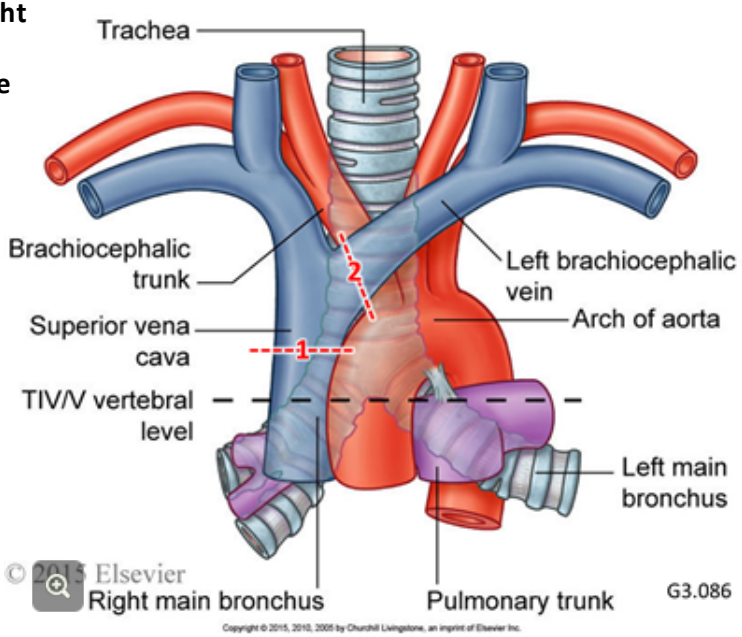
TASK

NEXT, TRANSECT the left brachiocephalic vein

where it meets the right brachiocephalic vein (2).

Gently, using blunt dissection, reflect the right and left brachiocephalic veins and their tributaries superolaterally, thus exposing the branches arising from the arch of the aorta

By cutting and reflecting the great veins, rather than removing them, you are able to return them to their original position for you and for others to review this anatomy.



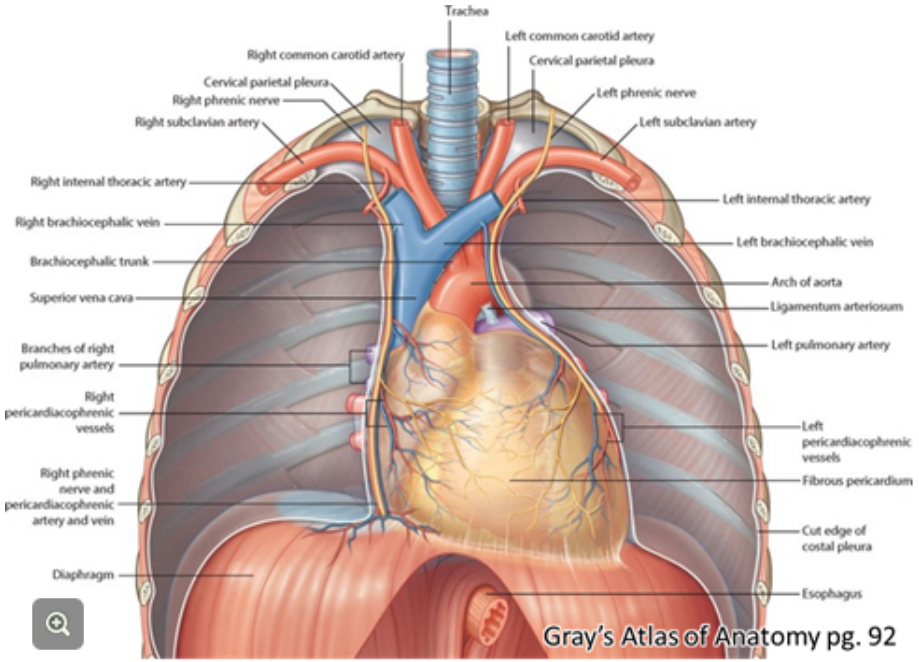
TASK

IDENTIFY the phrenic nerves, bilaterally.

They lie on the anterior surface of the anterior scalene muscle in the neck and cross anterior to the subclavian arteries into the thorax.

Notice that they pass anterior to the root of the lung on their way to the diaphragm.

Unless the nerve has been completely cleaned, you will notice that the phrenic nerves are accompanied by blood vessels, the pericardiophrenic arteries and veins. These are branches of the internal thoracic arteries and veins.



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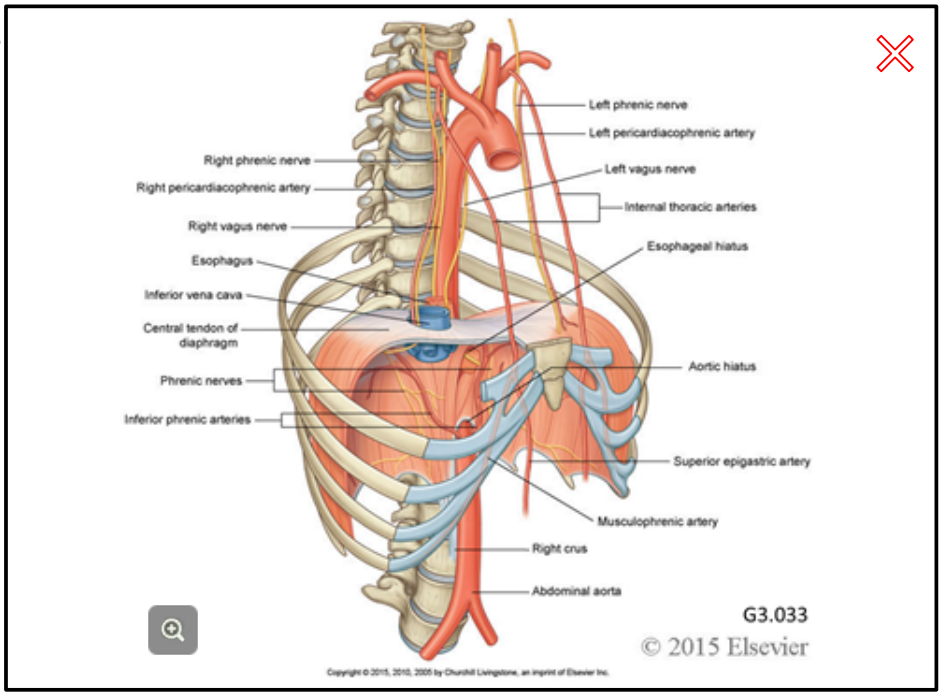
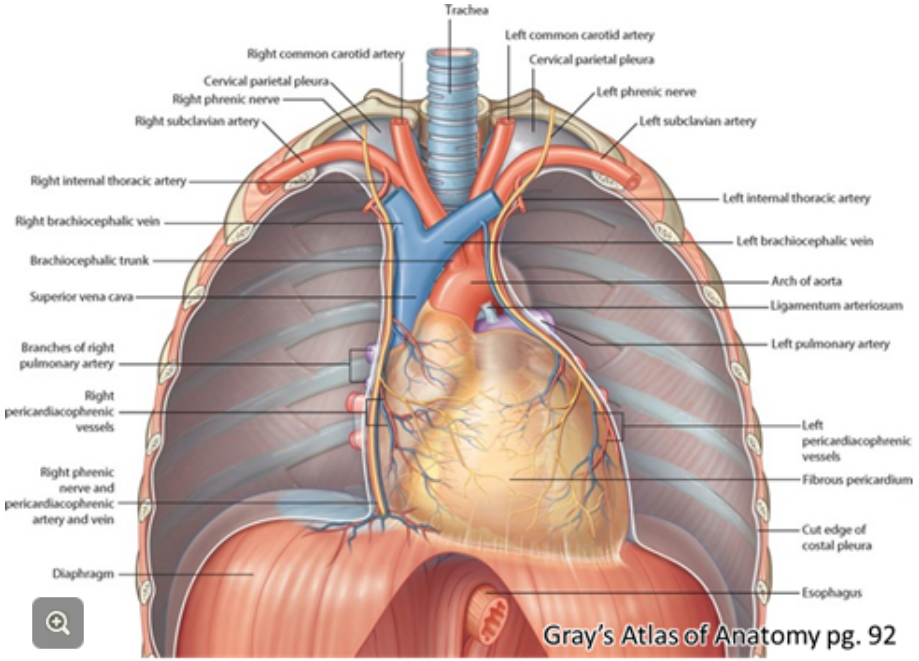


The **phrenic nerves** and **pericardiophrenic arteries** and **veins** run in loose CT, **sandwiched between the mediastinal parietal pleura and the fibrous pericardium**. The **pericardiophrenic vessels** supply the **pericardial sac** and **mediastinal pleura**, as well as contributing to the blood supply of the **diaphragm**.

In addition to supplying **motor fibres** to the ipsilateral hemidiaphragm, each **phrenic nerve** supplies **sensory fibres** to the **pericardial sac**, **mediastinal parietal pleura**, **hemidiaphragm** and its serous coverings, both the **diaphragmatic parietal pleura** on its superior surface and the **parietal peritoneum** on its inferior surface.



TASK

IDENTIFY THE ARCH OF THE AORTA

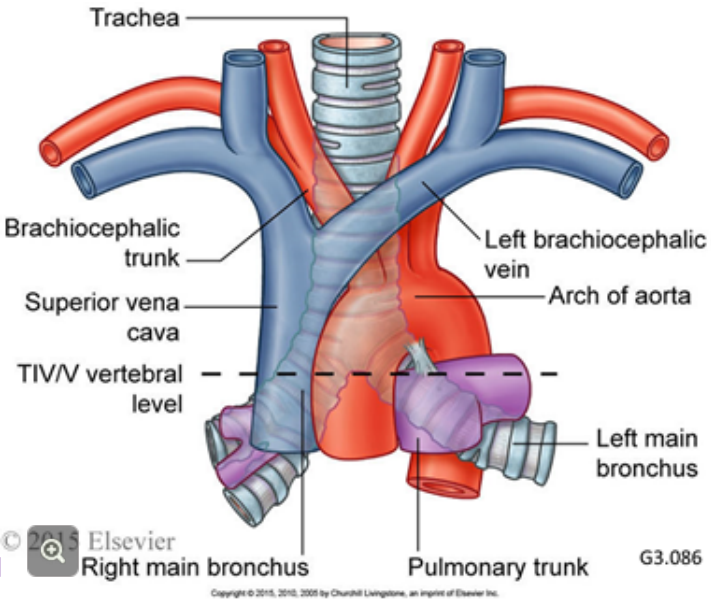
and realize that it begins and ends at the level of the sternal angle. Identify the three branches of the aortic arch, the brachiocephalic trunk, the left common carotid artery and the left subclavian artery.

Identify the branches of the brachiocephalic trunk, the right subclavian artery and the right common carotid artery.

Identify the first branch of the subclavian artery, the vertebral artery. Recall that it ascends in the neck through the foramen transversaria of the cervical vertebrae.

Identify and clean the stumps of the internal thoracic arteries. Can you identify the origin of the pericardiophrenic arteries arising from the stump of the internal thoracic arteries?

Identify and clean the thyrocervical trunk. Recall that it gives rise to the inferior thyroid artery. **In cadaver 1, identify the inferior thyroid artery ascending to the thyroid gland.**

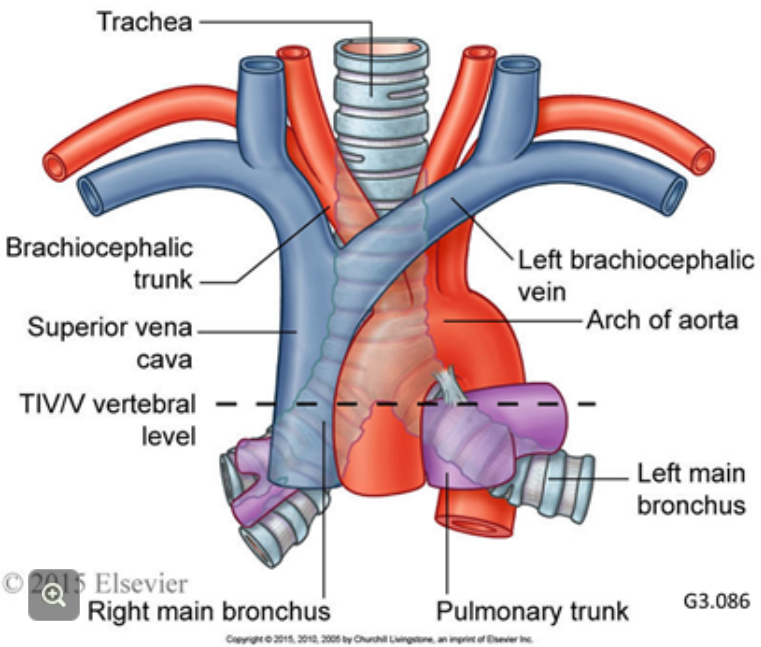


TASK

NOTICE THAT THE BIFURCATION OF THE pulmonary trunk also occurs at the level of the sternal angle, and that the aorta arches over the bifurcation of the pulmonary trunk, from anterior to posterior.

Identify the ligamentum arteriosum, a fibrous band that connects the pulmonary arteries to the inferior surface of the arch of the aorta. The ligamentum arteriosum is a remnant of the fetal ductus arteriosus.

The significance of the ductus arteriosus to the fetal circulation will be described in Lab 8.



Since embarking on this exercise, you have **identified** the following structures and learned the **answers to the following questions**:

- Describe the borders of the mediastinum. Describe the borders of its four subdivisions.
- Describe the location of the thymus gland.
- Identify the superior vena cava, the brachiocephalic veins, the origins of the internal thoracic veins, the internal jugular veins and subclavian veins, the azygous vein.
- Trace the phrenic nerves and note their relationships to the anterior scalene muscles, the subclavian artery and the root of the lung. What are their companion vessels? Between what two layers does this neurovascular bundle lie? Describe their distribution.
- Identify the arch of the aorta and its three branches. Identify the right subclavian and common carotid arteries. Identify the vertebral and internal thoracic arteries, the thyrocervical trunk and inferior thyroid artery.
- Identify the pulmonary trunk and its bifurcation, and the ligamentum arteriosum.

Pause here to assess your learning. Quiz each other thoroughly. If you are satisfied with your **ability to identify these structures** and **answer these questions, move on** to the next stage of the exercise.

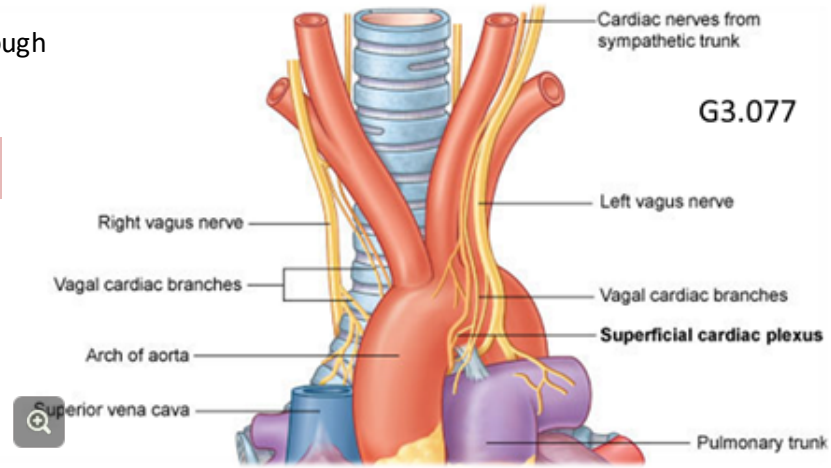
TASK

IDENTIFY the left vagus nerve passing across the left side of the arch of the aorta.

Identify its recurrent laryngeal branch passing under the arch of the aorta, posterior to the ligamentum arteriosum, to ascend into the neck between the trachea and esophagus.

In Cadaver 1, since the neck was already dissected, you can now follow the left recurrent laryngeal nerve all the way to the larynx.

The vagus nerves feeds into the **cardiac plexus**, the **pulmonary plexus** and the **esophageal plexus** before passing through the diaphragm into the abdomen in the company of the esophagus.



TASK

OBSERVE that

the left vagus nerve continues inferiorly, posterior to the root of the left lung toward the esophagus, where it feeds into the esophageal plexus.

Remember that sympathetic postganglionic fibres arising from the chain ganglia also feed into all of these plexuses.

TASK

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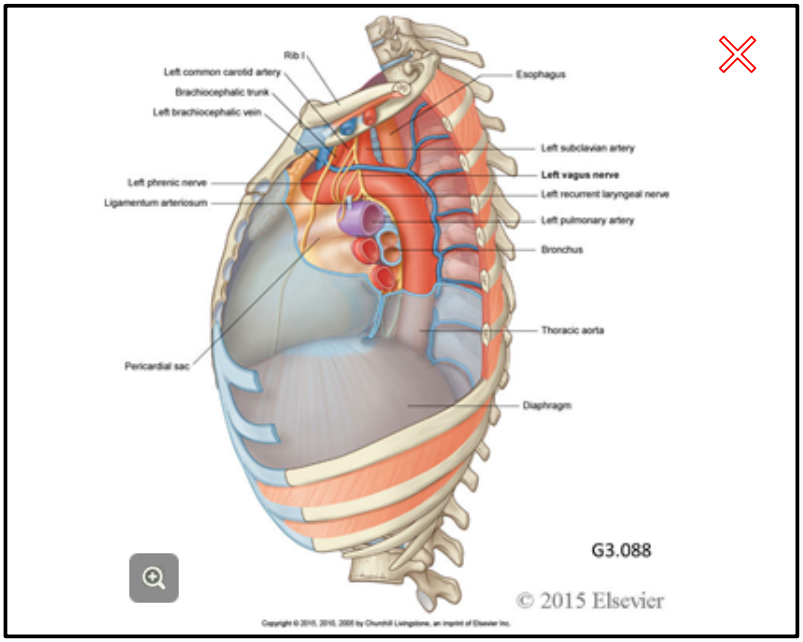


TASK

OBSERVE that

the left vagus nerve continues inferiorly, posterior to the root of the left lung toward the esophagus, where it feeds into the esophageal plexus.

Remember that sympathetic postganglionic fibres arising from the chain ganglia also feed into all of these plexuses.

INFO

Paralysis of the Left Vocal Fold

The left recurrent laryngeal nerve can be compressed and damaged by a space-occupying lesion in the mediastinum, such as a mediastinal tumor or an aortic aneurysm.

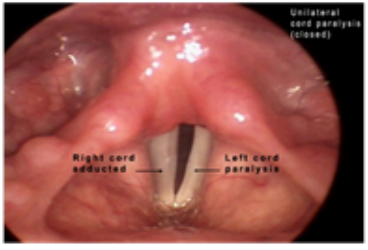
This can lead to **paralysis of the left vocal fold**. The voice will be breathy or hoarse because the vocal folds cannot meet in the middle during phonation.

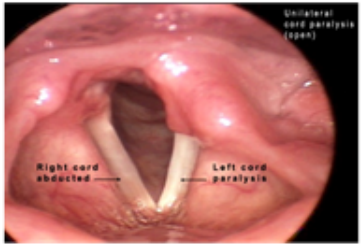
Normal

Adducted vocal folds, as in speaking.

Abducted vocal folds, as in breathing.

Unilateral paralysis of the left vocal fold





Notice that the left vocal fold does not meet the right in the midline when speaking. Nor does it abduct when breathing.

http://app1.unmc.edu/medicine/heywood/laryngealdisease/Data/abnormalfunction.htm

TASK

IDENTIFY the right vagus nerve.

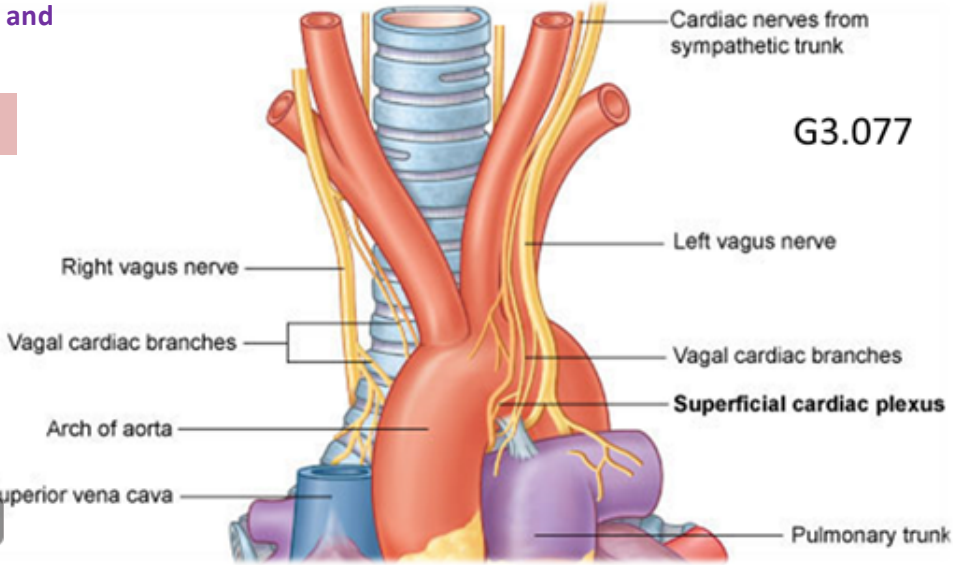
Identify its recurrent laryngeal branch. Notice that the right recurrent laryngeal nerve recurs around the right subclavian artery to ascend in the neck between the trachea and esophagus. Again, on Cadaver 1, since the neck has already been dissected, follow the right recurrent laryngeal nerve all the way to the larynx.

The right vagus nerve also feeds into the **cardiac, pulmonary and esophageal plexuses**.

TASK

OBSERVE that

the right vagus nerve continues inferiorly, posterior to the root of the right lung toward the esophagus, and the esophageal plexus.



TASK

IDENTIFY the right vagus nerve.

Identify its recurrent laryngeal branch. Notice that the right recurrent laryngeal nerve recurs around the right subclavian artery to ascend in the neck between the trachea and esophagus. Again, on Cadaver 1, since the neck has already been dissected, follow the right recurrent laryngeal nerve all the way to the larynx.

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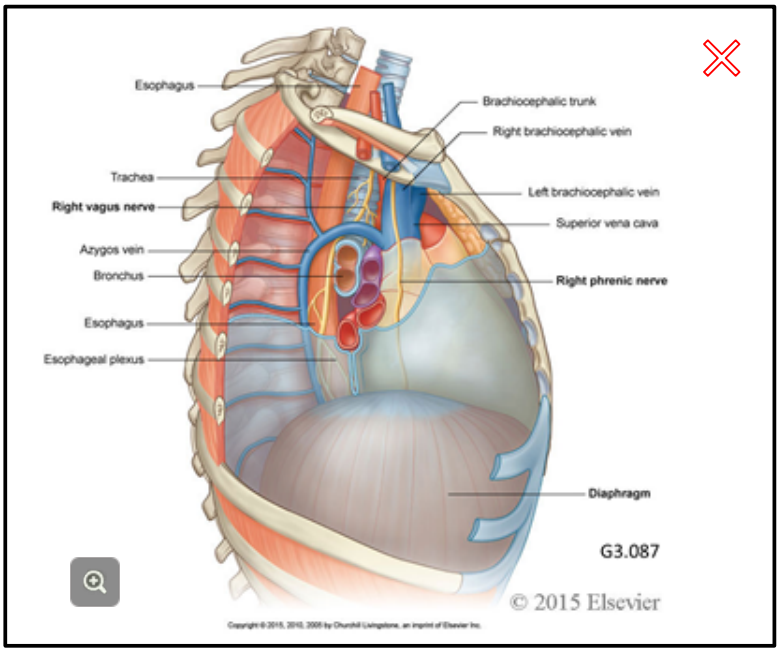


TASK

IDENTIFY the trachea,

and follow it inferiorly to its bifurcation at the level of the sternal angle. Identify the right and left primary bronchi. Notice that the right primary bronchus is larger in diameter, more vertically oriented and shorter than the left primary bronchus.

This is because the left lung is farther from the midline than the right, meaning that the left primary bronchus must travel farther to meet the hilum of the left lung.

TASK

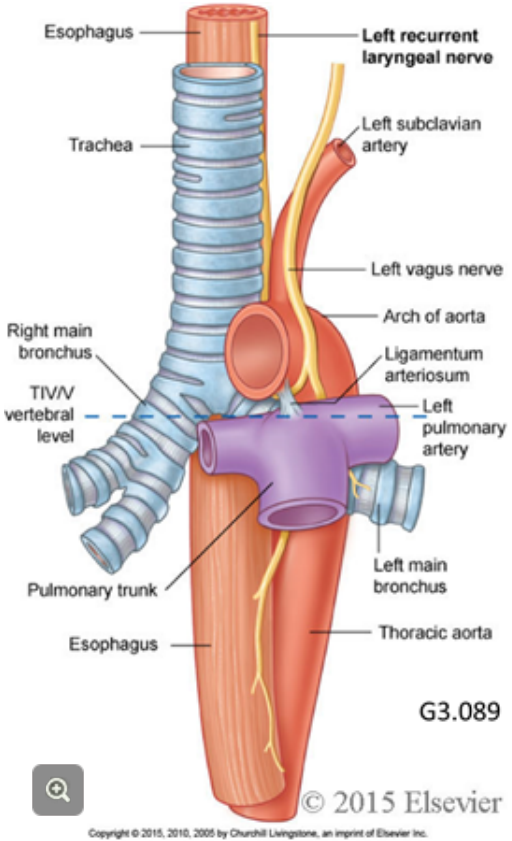
NOTICE that the azygous vein

arches over the right primary bronchus, while the aorta arches over the left primary bronchus.

TASK

PALPATE the trachea,

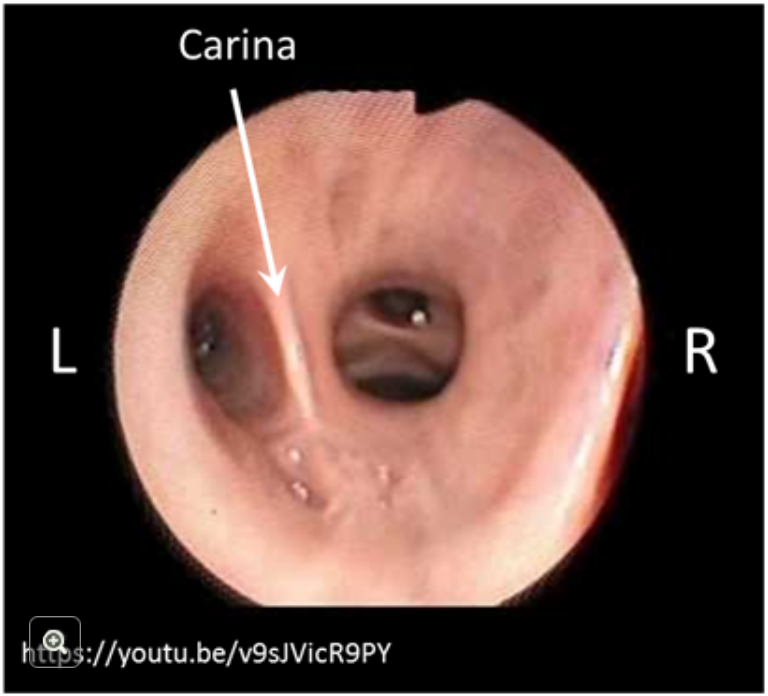
front and back, at its point of bifurcation. Observe that tracheal cartilages are C-shaped, and open posteriorly toward the esophagus.



INFO

THE CARINA as a landmark in bronchoscopy

The **carina** is the cartilage located at the bifurcation of the trachea. It is a landmark in bronchoscopy. Because the right primary bronchus is larger in diameter and more vertically oriented than the left, articles that are aspirated are more likely to lodge in the right bronchial tree than the left.



Since the last Progress Check, you have **identified** the following structures and learned the **answers to the following questions**:

- Identify the left and right vagus nerves and their recurrent branches. Around what structures does each recur? How does a lesion of a recurrent laryngeal nerve affect the larynx?
- Trace both vagi toward the esophagus and be able to describe their course relative to other mediastinal structures, such as the roots of the lungs.
- Identify the trachea and the right and left primary bronchi. What is the carina? Describe three ways in which the right and left primary bronchi differ, and the clinical significance of this.
- What vessel arches over the right primary bronchus? What vessel arches over the left primary bronchus?
- The plane between the sternal angle and the intervertebral disc between the T4 and T5 vertebrae is an important anatomical landmark, not only because it separates the superior from the inferior mediastinum. Go back to slides 10, 14, 15, and 19 and compile a list all of four things that happen at this level.

If you are satisfied with your **ability to identify these structures** and **answer these questions**, call your TA over for confirmation and for **permission to move on** to the next exercise.

Replace the structures of the superior mediastinum carefully back in their original positions. Moisten the thoracic contents. Cover them with moist cloths. Replace the chest plate to its correct position. Cover the entire chest with moist cloths and close the body bag.

When your colleagues come to learn from your work, and when you come back to review, all structures should be in their correct anatomical position.

7.3 Fascial Compartments and Vasculature of the Lower Limb

What you'll need:

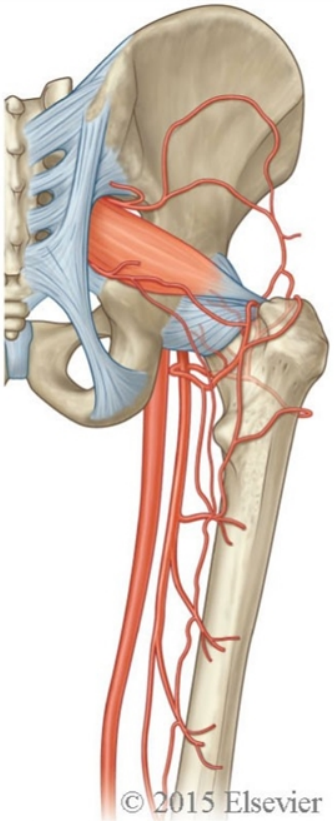
SPECIMENS

- prosected lower limbs

Remember: you must not use sharp tools on a prosection. Use, at most, a bent probe to point out structures to your colleagues.

When you have learned the material presented in this exercise, you will be able to recognize and describe the:

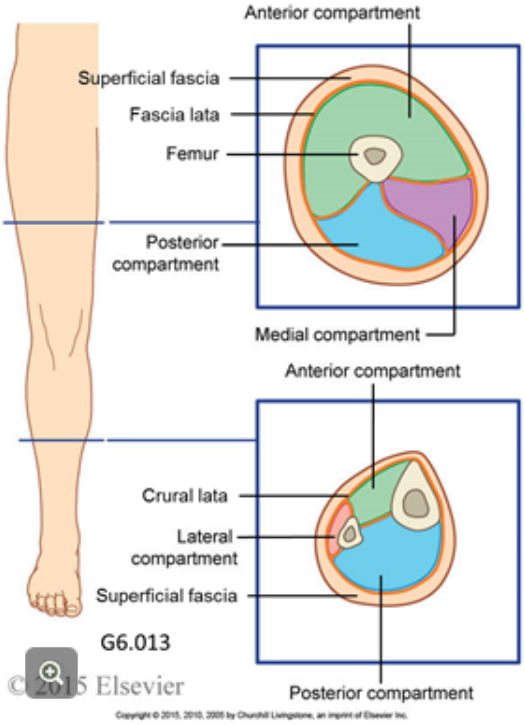
- deep fascia of the lower limb.
- fascial compartments of the lower limb.
- major arteries and deep veins of the lower limb.
- superficial veins of the lower limb.
- major groups of lymphatics in the lower limb.



Deep to the skin of the limbs is a layer of **superficial fascia** consisting of **loose connective tissue (CT)** and containing a variable amount of **adipose**. It is continuous with that covering the remainder of the body, such as **Camper's fascia** of the abdominal wall. This layer can also be called the **hypodermis**.

Below the superficial fascia is a **deep fascia** composed of **dense CT** that surrounds the musculature of the body. It is particularly robust in the limbs, where it forms **sleeve-like structures** that enclose muscles. In the lower limb it forms the **fascia lata** of the thigh and the **crural fascia** of the leg.

Septae extend from this enveloping fascia to the bones of the limb, creating **compartments** that contain groups of muscles, nerves, blood vessels and lymphatics. Because the deep fascia and septae are composed of inextensible dense CT, fluid accumulation within these compartments increases pressure, compressing their contents, including nerves and blood vessels. This can lead to **compartment syndromes**.



The muscles within a compartment often have **common actions** and **nerve supplies**, as you will learn in Unit 5, next September. For now, you will focus on the fascia, fascial compartments and vasculature of the lower limb.

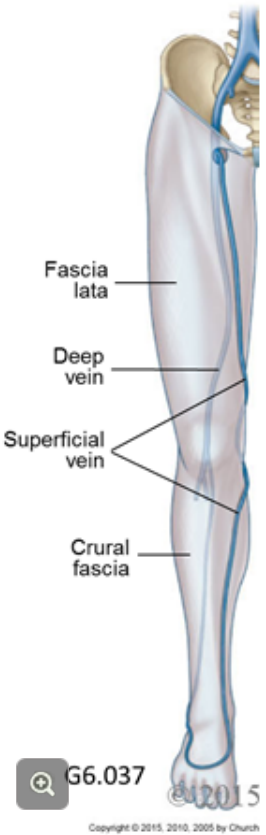
There are two sets of veins in the body, deep and superficial. **Deep veins accompany arteries**, usually with the same name. **Superficial veins** have **no accompanying arteries**. In the limbs, deep veins are located within the fascial compartments with the muscles, while **superficial veins** run in the **superficial fascia** of the limb. Shunting of blood between the two sets of veins functions in **temperature regulation; the greater the volume of blood in the superficial veins, the greater the heat loss, and vice versa.**

Superficial veins end by draining into **deep veins**. The deep veins then ultimately drain into either of the **venae cavae**, thus returning all systemic venous blood to the **right atrium**.

In the lower limb, superficial veins begin at the **dorsal venous arch**, which collects blood from the foot and drains it proximally. The dorsal venous arch continues laterally as the **small saphenous vein**, which passes **posterior to the lateral malleolus** and it continues medially as the **great saphenous vein**, which passes **anterior to the medial malleolus**.

The **small saphenous vein** continues in the **posterior midline** of the leg to the level of the **popliteal fossa**. At this level, the small saphenous vein passes through an opening in the deep fascia of the leg to **drain into the deep venous circulation by emptying into the popliteal vein**.

The **great saphenous vein** crosses the knee a **hands-breadth posterior to the medial border of the patella** (see image on base layer), and from there, it takes a relatively straight course toward the inguinal ligament.



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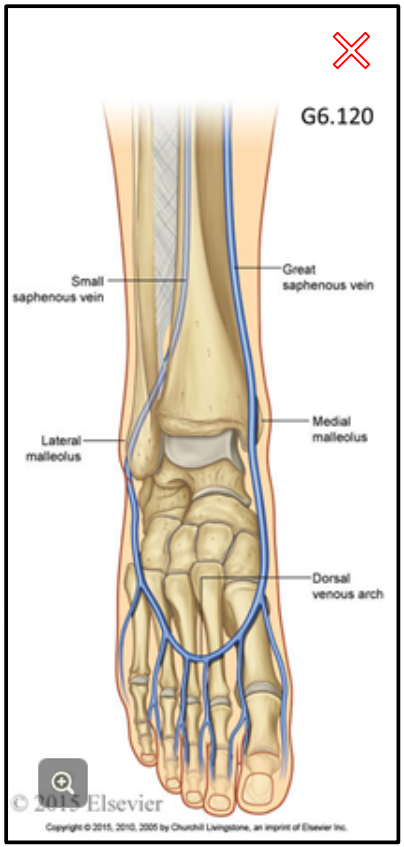

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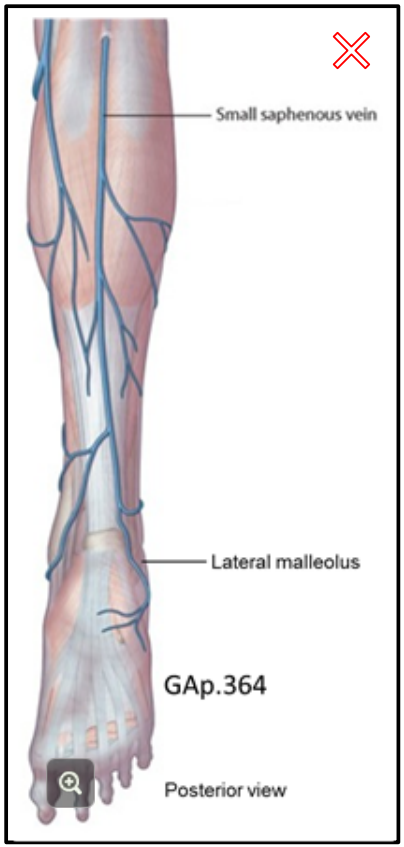


TASK

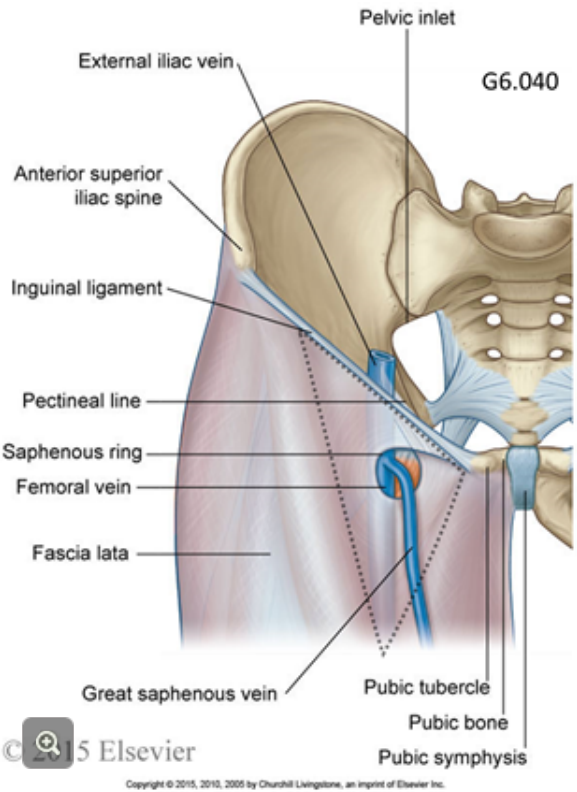
MAKE A PILGRIMAGE to Grant's Museum

of Anatomy and look at specimen L48. It illustrates the deep fascia and superficial veins, nerves and lymphatics of the thigh.

Identify the fascia lata, the deep fascia of the thigh, which appears as an opaque, whitish layer surrounding the muscles of the limb. Identify the iliotibial tract / band, a thickening of the fascia lata along the lateral aspect of the thigh.

Identify the femoral triangle, the region just inferior to the inguinal ligament. Trace the great saphenous vein into the femoral triangle to where it disappears from view. It is in the femoral triangle that the great saphenous vein passes through the **saphenous ring**, an opening in the fascia lata, to access the deep venous system and empty into the **femoral vein**.

Review the superficial venous drainage of the lower limb through surface anatomy here: . Be able to identify the veins illustrated in these surface anatomy photographs **without** the colour-coding!



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In preparing the Museum specimen you are studying, the skin and superficial fascia of the lower limb was removed. Left behind are the **superficial nerves**, **lymphatic vessels** and **lymph nodes** of the thigh.

TASK

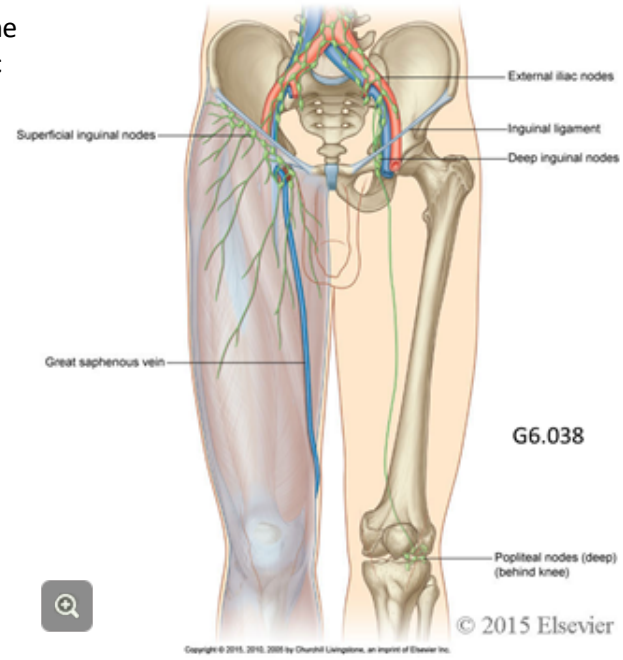
IDENTIFY, in Museum specimen L48, superficial nerves and lymphatic vessels

ramifying over the fascia lata. Superficial nerves provide cutaneous sensation and sympathetics to the skin and superficial fascia. The superficial lymphatic vessels collect lymph from these same tissues and drain toward the inguinal triangle. **Identify the superficial inguinal nodes in the inguinal triangle, associated with the inguinal ligament and the terminus of the great saphenous vein**; these nodes receive lymph from the superficial lymphatic vessels and process it for antigen.

Not seen in this specimen are the **deep nodes** that are associated with the **femoral and popliteal veins**.

In addition to lymph from the lower limb, the superficial inguinal lymph nodes also receive lymph from superficial tissues of their corresponding **abdominal quadrant**, structures of the **perineum** (other than the testes, which drain to para-aortic nodes), and the **gluteal region**.

Superficial inguinal lymph nodes drain into **deep inguinal nodes**, which in turn drain into the **external iliac nodes**.



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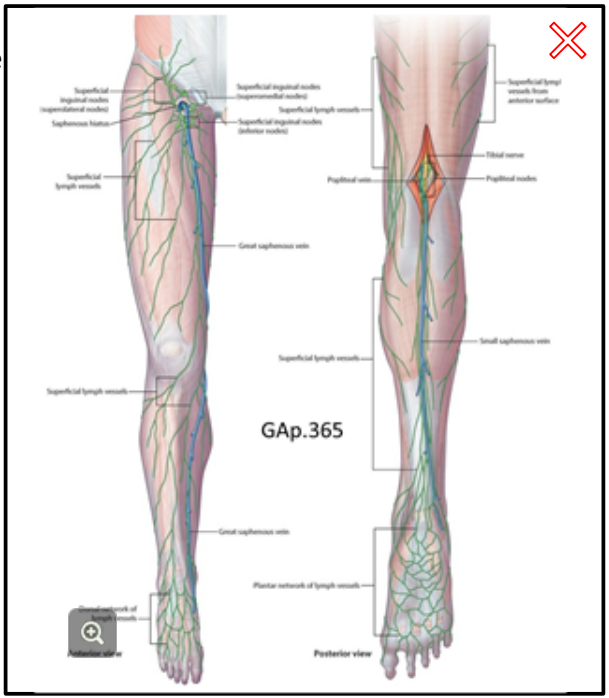
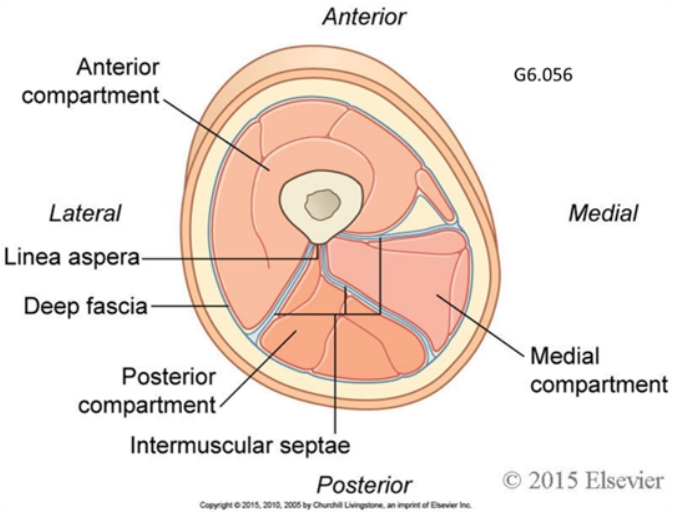


Since embarking on this exercise, you have **identified** the following structures and learned the **answers to the following questions**:

- Describe the superficial and deep fascia of the lower limb. Of what type of tissue is each composed?
- What is the specific name of the deep fascia of the thigh? of the leg? What are septae?
- What is the anatomical basis of a compartment syndrome?
- What is the iliotibial band (tract)?
- What is the functional significance of two separate sets of veins, deep and superficial?
- Describe the dorsal venous arch and the courses of the great and small saphenous veins. Be able to identify these in surface anatomy. Where does each empty into the deep system of veins?
- What is the single major group of superficial lymph nodes in the lower limb? From what body regions do these superficial nodes collect lymph?

Pause here to assess your learning. Quiz each other thoroughly. If you are satisfied with your **ability to identify these structures** and **answer these questions**, move on to the next stage of the exercise.

Dense CT intermuscular septae emanating from the fascia lata merge with the periosteum of the femur to subdivide the thigh into three compartments: **anterior, posterior and medial**. The muscles in each of these compartments have common actions, with the muscles of the anterior compartment extending the knee and the muscles of the posterior compartment flexing the knee. The muscles of the medial compartment largely act at the hip, which they adduct.



You will now return to you lab to study a specimen dissected to demonstrate the muscles, nerves and blood vessels of the lower limb. The CT septae will have largely been removed during dissection. For now, you will focus your study on **the blood vessels of the lower limb**.

TASK

UNWRAP the prosected lower limb.

Orient yourself to the specimen by identifying its proximal and distal ends, and laying it on the table dorsal side down. For the sake of simplicity, in much of the text that follows, and in many of the accompanying diagrams, only the artery is described and illustrated; however, **realize that deep veins accompany the arteries and take the same names.**

TASK

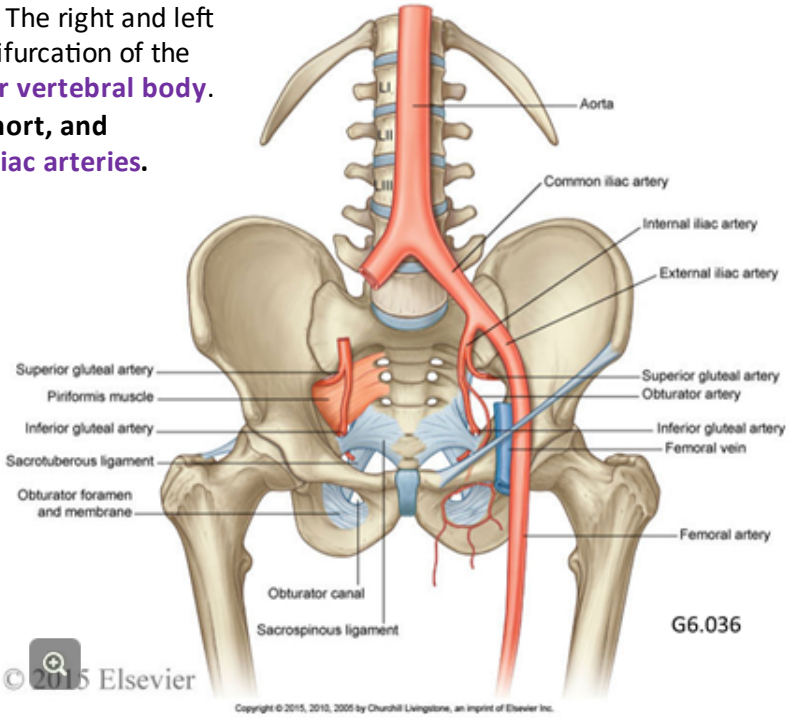
In the pelvis, IDENTIFY the common iliac artery

anterior to the ala of the sacrum. The right and left common iliac arteries arise from the bifurcation of the aorta at the level of the **fourth lumbar vertebral body**.

Observe that the common iliac artery is short, and bifurcates into the external and internal iliac arteries.

Confirm that the internal iliac artery is smaller than the external, and enters the true pelvis. There, it gives numerous visceral branches to pelvic organs, as well as branches that pass out of the pelvis through the **greater sciatic foramen** to supply the **gluteal region** and a branch that passes out of the pelvis through the obturator canal to supply the medial thigh.

Look for the obturator artery, the branch of the internal iliac artery that passes through the obturator canal into the medial compartment of the thigh.

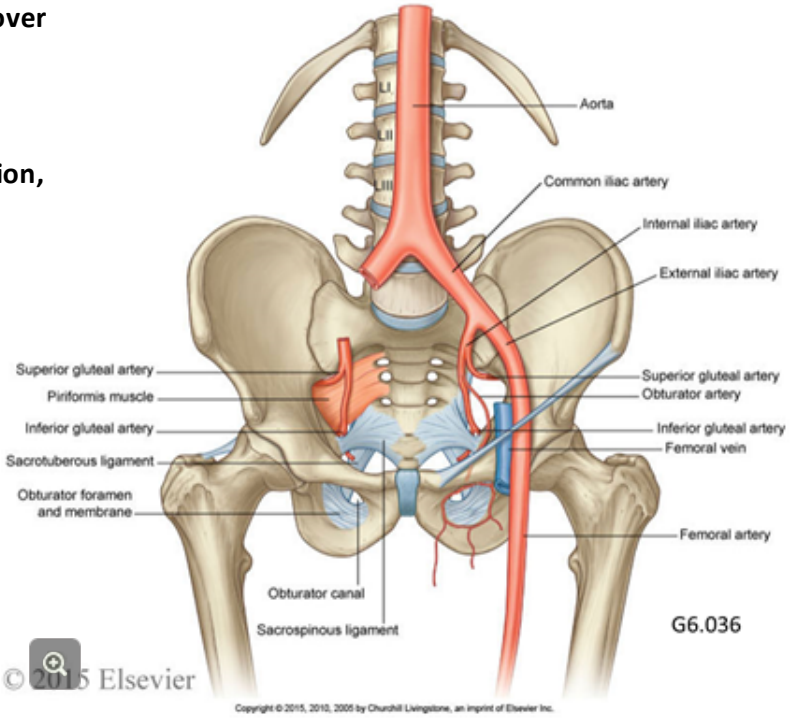


TASK

LOCATE the larger external iliac artery skirting the pelvic brim and passing over the superior pubic ramus into the anterior thigh at about the midpoint between the ASIS and the pubis. If the inguinal ligament is intact in your prosection, you'll see that the artery leaves the false pelvis by passing deep to the inguinal ligament.

TASK

IDENTIFY, if it is present, the external iliac vein medial to the external iliac artery, and notice that this relationship is maintained as the vessels enter the thigh. Identify the venous branches that correspond to those of the artery described above, if they are present in your specimen.



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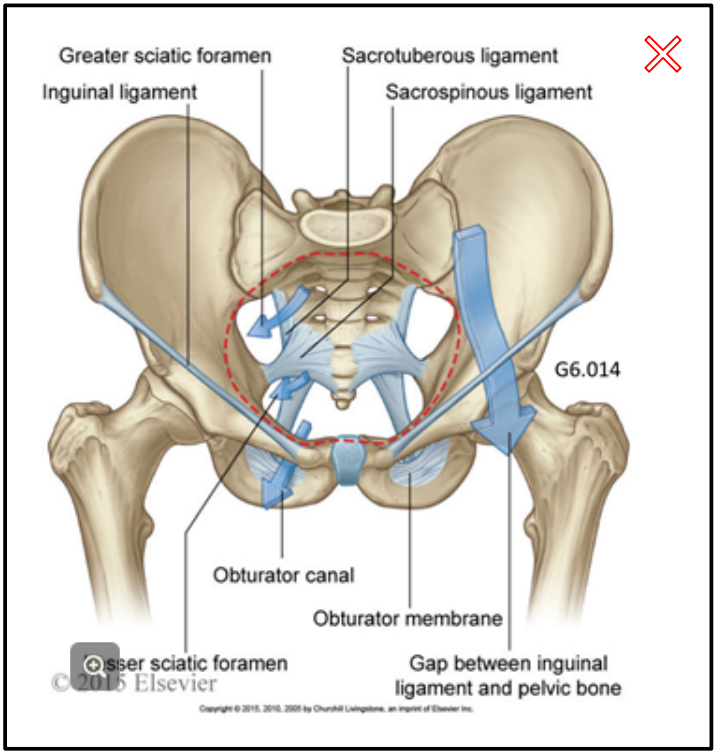


On passing under the inguinal ligament, the external iliac artery and vein change names to become the **femoral artery and vein**.

TASK

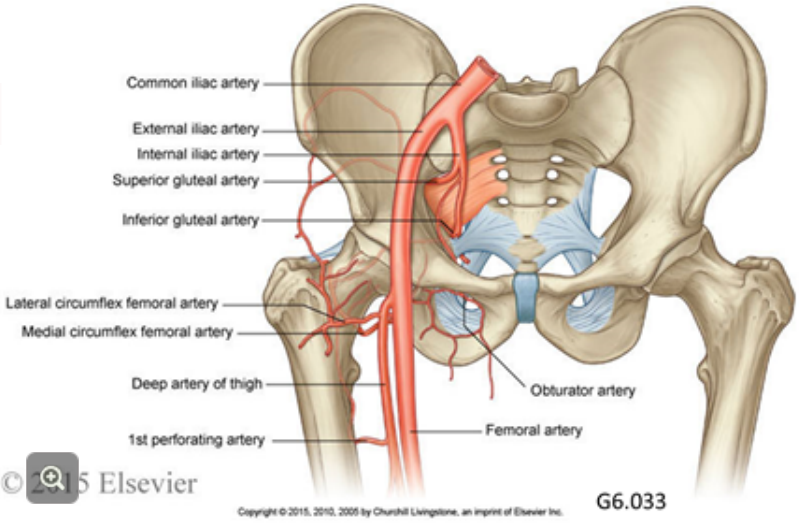
IDENTIFY the femoral artery

in the femoral triangle.

INFO

A femoral pulse can be felt

within the femoral triangle, roughly half way between the ASIS and the pubic tubercle. The right and left femoral pulses should be symmetrical and easily felt in a healthy individual.



TASK

Carefully EXPLORE

the proximal end of the femoral artery and identify its first branch, the deep femoral artery (deep artery of the thigh).

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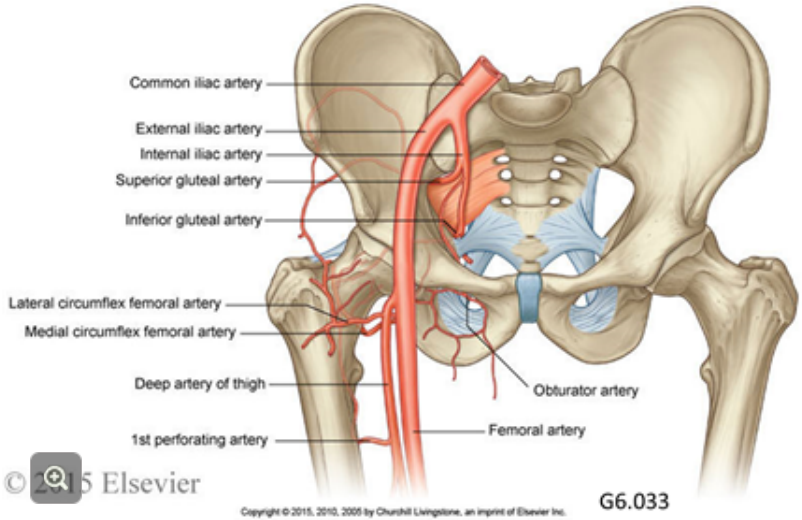
The **femoral artery** is like an expressway, while the deep femoral artery is like collector lanes. The femoral artery largely functions to deliver blood to the leg, and as such, has few branches in the thigh.

The **deep femoral artery**, on the other hand, gives many branches in the thigh, and these branches are responsible for supplying the hip joint, the tissues of the anterior and posterior compartments of the thigh, and some of the medial compartment, as well.



TASK

IDENTIFY the medial and lateral femoral circumflex arteries.

These branches usually arise from the proximal end of the deep femoral artery, but one (or uncommonly both) may arise from the femoral artery.

These vessels encircle the neck of the femur and their branches **ascend the neck of the femur to supply its head**. Corresponding veins drain these regions back to the femoral vein. Do not attempt to find them.

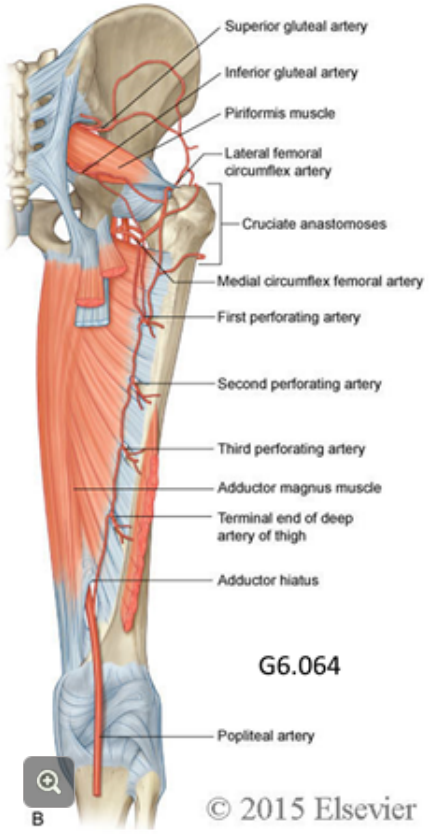
It is stating the obvious to say that branches of the **deep femoral artery** supply the tissues of the anterior compartment of the thigh. It is less intuitive, however, to learn that branches of the deep femoral artery also supply the tissues of the posterior compartment of the thigh, as well as contributing to the blood supply of the medial compartment. This is the role of the **perforating branches of the deep femoral artery**.

TASK

Turn the prosection over and EXPLORE

the posterior compartment of the thigh. There you will find perforating branches of the deep femoral artery entering the posterior compartment by passing through ("perforating") the attachment of the adductor magnus to the length of the linea aspera of the femur. The adductor magnus is a major muscle in the medial compartment of the thigh.

Corresponding veins drain the posterior compartment of the thigh back to the deep femoral vein in the anterior compartment. Do not attempt to find them.



Turn your attention to the popliteal fossa, a diamond-shaped region in the posterior aspect of the knee. Adipose tissue normally packs the popliteal fossa, and **popliteal lymph nodes**, deep lymph nodes of the leg, are located here. These tissues have been removed from the prosection in order to make the vessels easier for you to find.

TASK

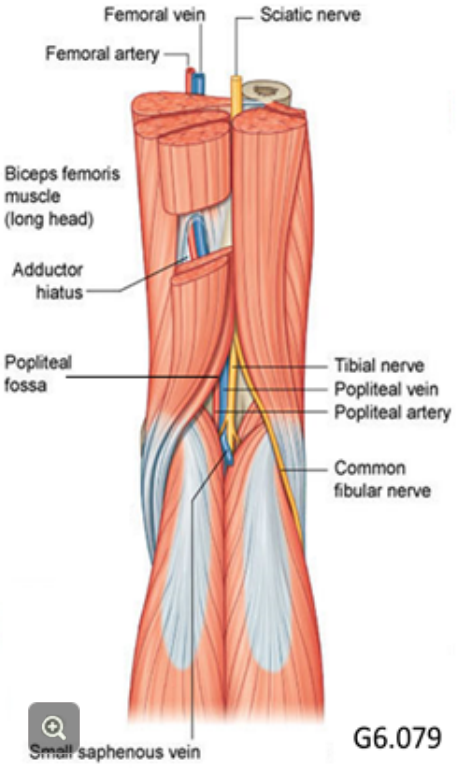
IDENTIFY the popliteal artery and vein

Follow these vessels proximally, and observe that they enter the popliteal fossa by passing through a large gap in the insertion of the adductor magnus called the adductor hiatus. The popliteal artery and vein **are the continuation of the femoral artery and vein**; the name change occurs as they pass through the adductor hiatus.

The **genicular anastomosis** is a rich anastomosis that surrounds the knee. It consists of descending and ascending genicular arteries which anastomose freely around the joint. It can provide a clinically significant alternative route for blood to travel distally when an obstruction blocks the main arterial path through the popliteal artery.

INFO

Popliteal Pulse



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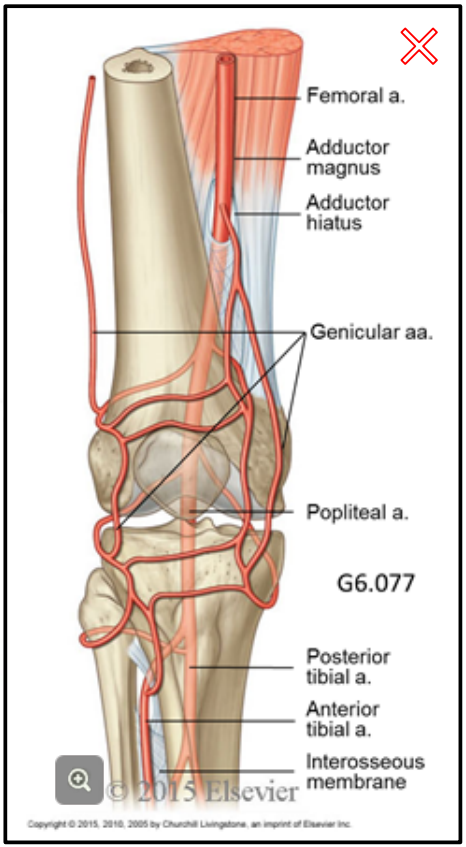
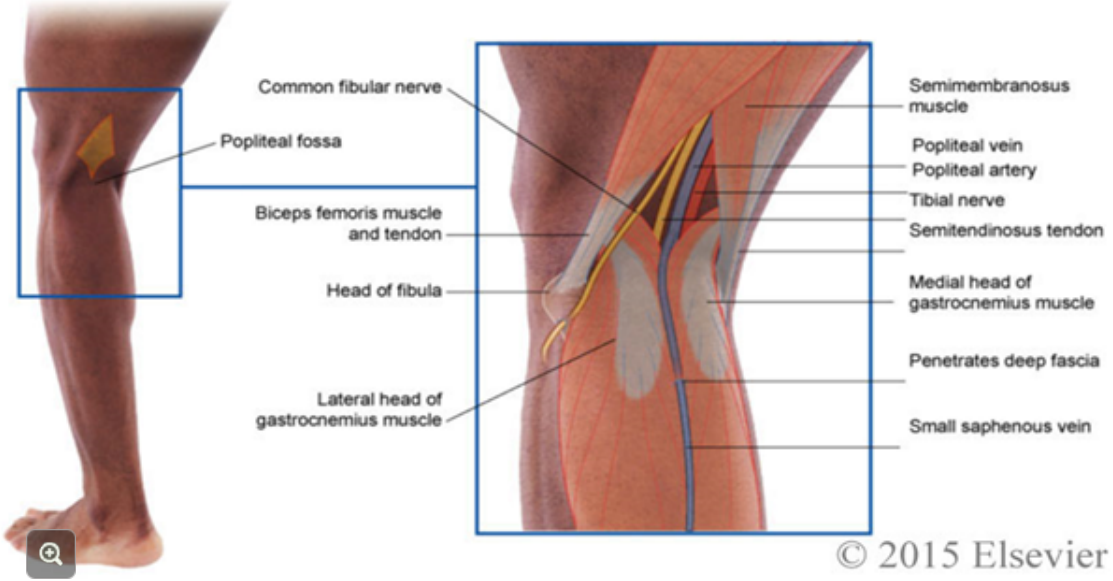


The Popliteal Pulse

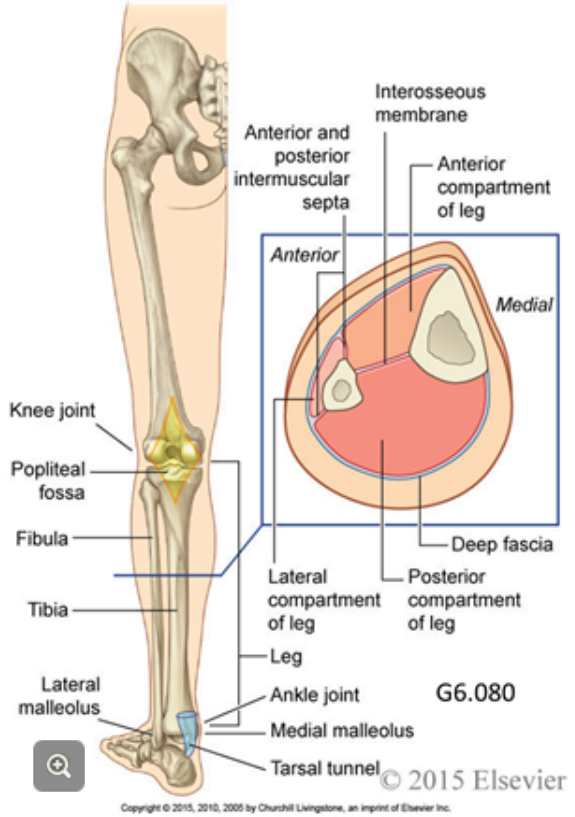
A popliteal pulse may be felt in the popliteal fossa. The popliteal artery is surrounded by much adipose tissue in the living person, and can be hard to locate without the application of significant pressure. Even then, it may not be palpable. This is not concerning if the distal pulses, the posterior tibial and dorsalis pedis pulses, can be found.



The tibia and fibula are joined by a dense sheet of CT, the **crural interosseous membrane**. In addition, dense CT intermuscular septae emanating from the deep fascia of the leg, the **crural fascia**, merge with the periosteum of the tibia and fibula.

These CT structures subdivide the leg into three compartments: **anterior, posterior** and, unlike the thigh, **lateral.** The muscles in each of these compartments have common actions, with the muscles of the anterior compartment **dorsiflexing** the talocrural (ankle) joint and the muscles of the posterior compartment **plantarflexing** the talocrural joint.

Certain muscles of these two compartments work synergistically to **invert** the foot. The muscles of the lateral compartment act to **evert** the foot.



TASK

FOLLOW the popliteal artery and vein into the leg,

deep to the "calf muscles", the gastrocnemius and soleus muscles. Observe that the popliteal artery branches, forming the anterior and posterior tibial arteries. Identify these branches and notice that the anterior tibial artery passes through an opening in the crural interosseous membrane to enter the anterior compartment of the leg. Notice that the posterior tibial artery continues in the posterior compartment, and quickly gives off a branch, the fibular artery, which also stays in the posterior compartment.

TASK

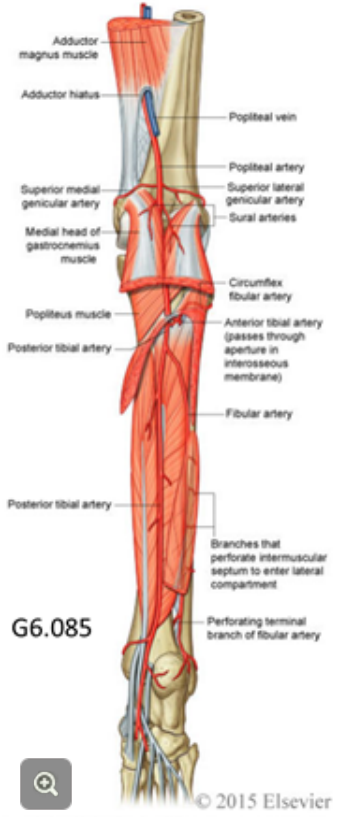
FOLLOW the posterior tibial artery

distally, behind the medial malleolus, where it passes into the foot to become the medial and lateral plantar arteries.

INFO

The pulse of the posterior tibial artery,

can be felt just posterior to the medial malleolus.



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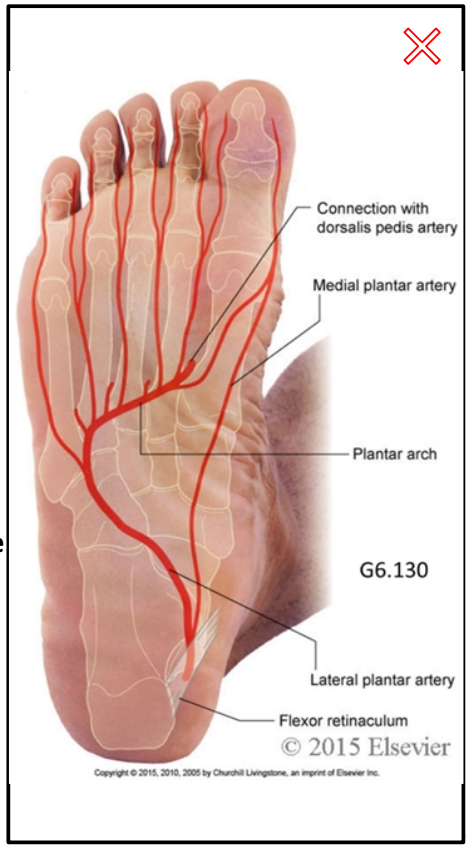

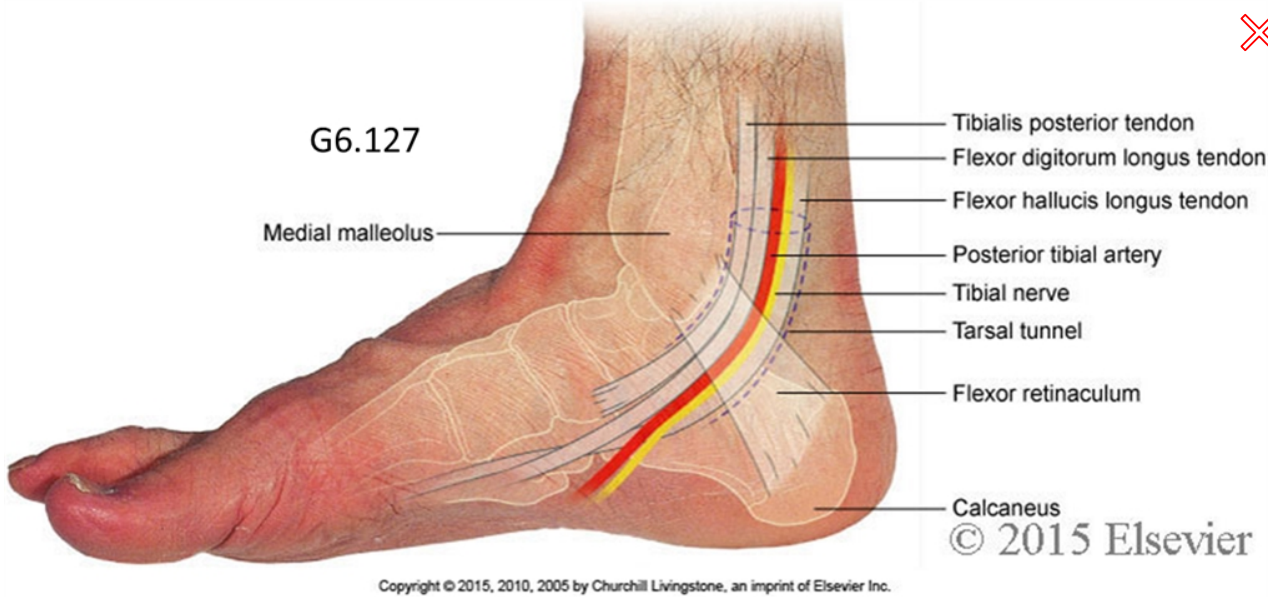

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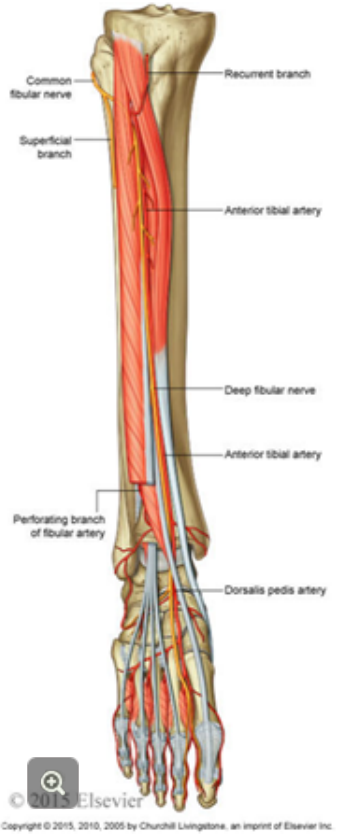
TASK

Turn the prosection over and find the anterior tibial artery in the anterior compartment of the leg by looking between the muscle bellies of this compartment. The anterior tibial artery may be located quite deeply, adjacent to the crural interosseous membrane. **Follow the anterior tibial artery distally until it passes into the foot anterior to the talocrural joint. Here the name of the vessel changes to the dorsalis pedis artery, because of its location on the dorsal surface of the foot. Identify the dorsalis pedis artery.**

INFO

The pulse of the dorsalis pedis artery, or the "pedal pulse" can be felt just lateral to the extensor hallucis longus (EHL) tendon. To find the EHL tendon, ask the patient to extend their great toe; i.e to turn it upward. This will cause the tendon of the EHL to "pop up". The pedal pulse can then be identified lateral to this landmark.



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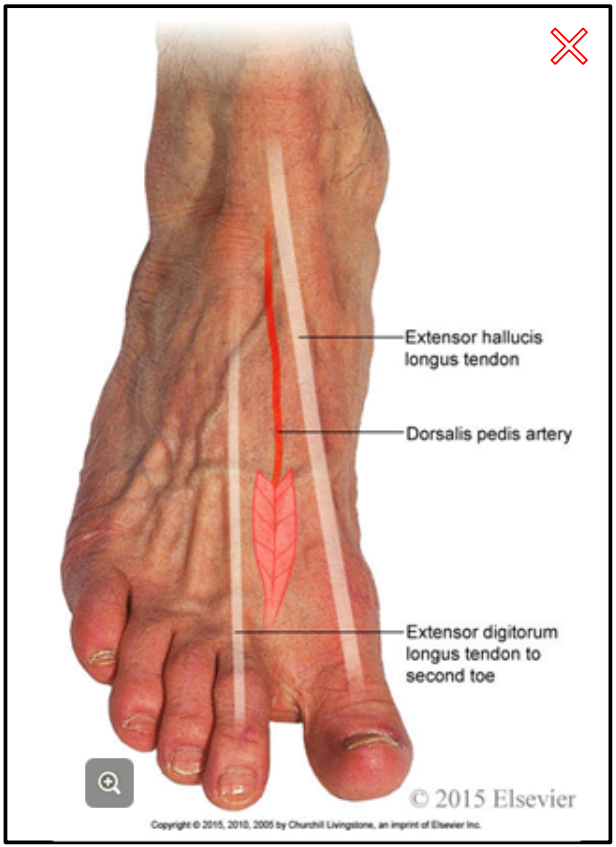
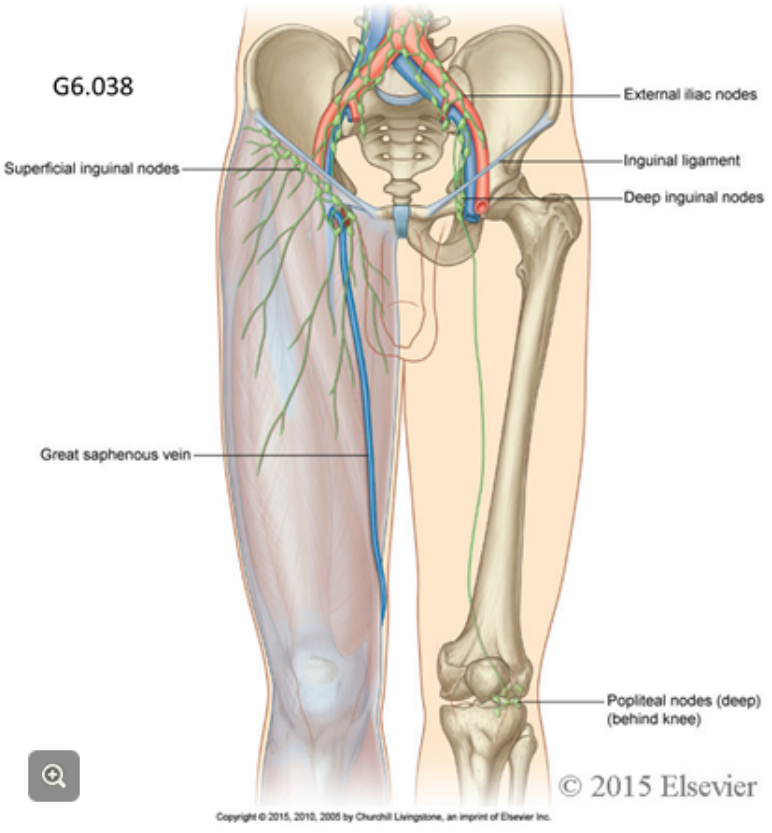


Once again, while the lymphatic drainage of the lower limb cannot be seen in the prosected specimen, it must be understood.

The deep lymphatics drain proximally alongside the deep veins of the limb.

Lymph passes through deep nodes of the leg, the **popliteal nodes**, located in the popliteal fossa, and continues to drain proximally alongside the femoral vein. It next passes through the **deep inguinal nodes**, located in the femoral triangle in association with the femoral vein . The deep inguinal nodes receive lymph from the **superficial inguinal nodes**, which are in the superficial fascia, associated with the terminus of the great saphenous vein. From the deep inguinal nodes, the lymph drains next through the **external iliac nodes** on its way to the **para-aortic nodes** and the **cisterna chyle.**



Since the last Progress Check, you have **identified** the following structures and learned the **answers to the following questions**:

- Identify the common iliac artery (where does it arise?), external and internal iliac arteries (name the branch of the internal iliac artery that supplies the medial thigh).
- Name the compartments of the thigh. Identify the femoral artery (where does the femoral vein lie, relative to the artery?), deep femoral artery, medial and lateral circumflex humeral arteries, perforating branches of the deep femoral artery, and popliteal artery. What is the name of the major arterial anastomosis around the knee?
- What is the landmark at which the external iliac artery and vein become the femoral artery and vein? What is the landmark at which the femoral artery and vein become the popliteal artery and vein?
- Name the compartments of the leg. Identify the anterior and posterior tibial arteries (How does the anterior tibial artery gain access to the anterior compartment of the leg?), fibular artery, dorsalis pedis, medial and lateral plantar arteries.
- Describe the location of four pulse points in the lower leg. Which one is particularly hard to palpate and why? What is the anatomical landmark for locating the dorsalis pedis pulse? What is the anatomical landmark for locating the posterior tibial pulse?
- What are the two major groups of deep lymph nodes in the lower limb? With what vessels are they associated?

If you are satisfied with your **ability to identify these structures** and **answer these questions**, call your TA over for confirmation and for **permission to move on** to the next exercise.