

LAB 8:

DISSECTION: CHEST WALL, OVERVIEW OF THORACIC CAVITY

GOALS

1. Clean the thoracic body wall to demonstrate the sternum, ribs, costal cartilages, and intercostal spaces
2. Remove the anterior thoracic wall; Inspect the pleural sacs and mediastinum
3. Open the pleural sacs and define the pleural cavity, parietal pleura, and visceral pleura
4. Remove the lungs
5. Strip away the parietal pleura on the right side and clean the structures on the posterior thoracic wall
6. Review the blood supply and venous drainage of the thoracic wall

BONY THORAX

Identify the following parts on bone specimens:

Sternum

- Manubrium, body, and xiphoid process
- Suprasternal notch and sternal angle

QUESTION



What is the significance of the sternal angle as an anatomic landmark?

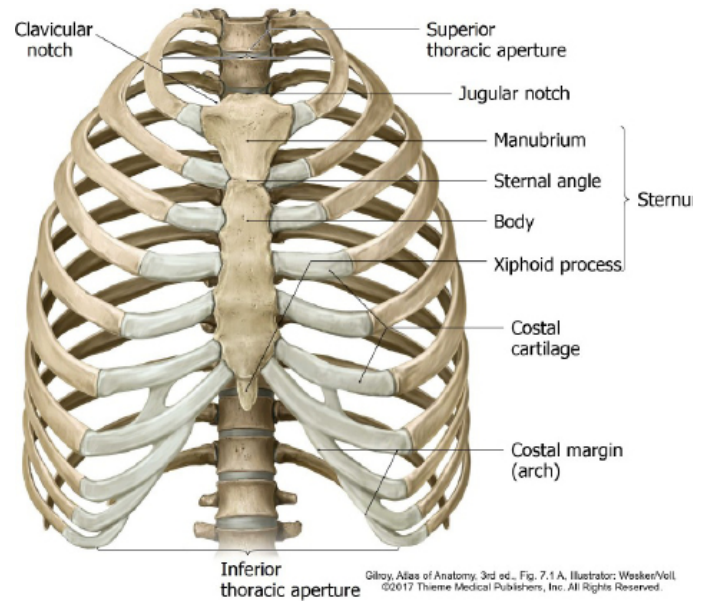


Figure 8.1.

Ribs and Rib Cage

- Ribs and costal cartilages
- True ribs = 1–7 [**Why are they named as such?**]
- False ribs = 8–12 [**Why are they “false”?**]
- Floating ribs (subset of false ribs = 11 and 12)
- Costal margin
- Superior thoracic aperture

QUESTION



What are the bony boundaries of the superior thoracic aperture? Which structures pass through the superior thoracic aperture? How do the lungs and pleura relate to the aperture?

The parts of a rib:

- **Head**
- **Tubercle**
- **Shaft**
- **Angle**
- **Costal groove** (**Which structures occupy this?**)

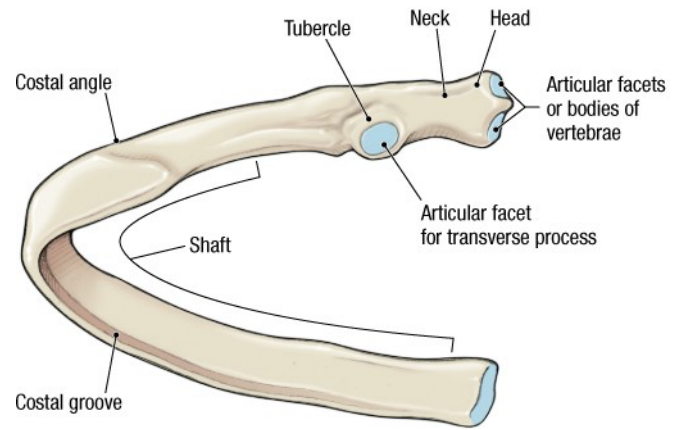


Figure 8.2. Grant's Dissector, 16th ed., Figure 3.2.



QUESTION

What are the gaps between adjacent ribs called?

Joints of the Thoracic Wall

- **Costovertebral joints:** Articulations between the rib head and the body/bodies of thoracic vertebrae.
- **Costotransverse joints:** Articulations between the rib tubercle and the transverse processes of vertebrae.

The costovertebral and costotransverse joints are plane (gliding) joints. Only slight movements occur at them. These movements are magnified at the distal ends of the ribs, to produce elevation of the ribs and sternum during respiration.

- **Costochondral joints:** Unlike the two joints listed above, these are not synovial type joints. Costochondral joints are the fusion of the distal part of a rib to the costal cartilage. No movement occurs—but pain can occur here due to inflammation (costochondritis) or separation of the joint due to trauma.

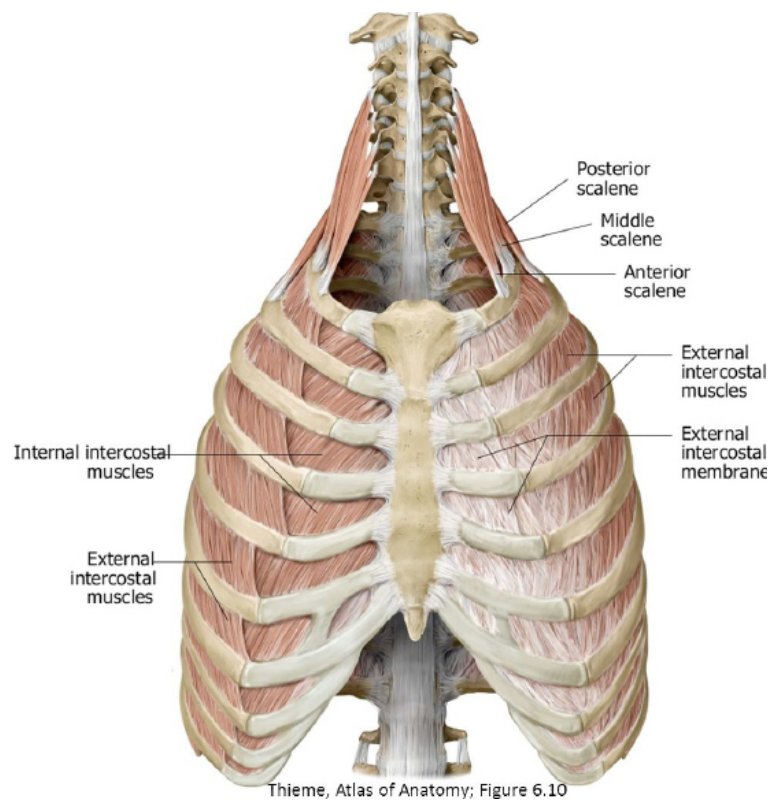
OUTER CHEST WALL



Inspect the anterior thoracic wall.

On the donor, identify these features of the thoracic wall:

- **Manubrium, body, and xiphoid process** of the **sternum**
- **Suprasternal (jugular) notch** and **sternal angle**
- **Ribs and costal cartilages**
- **Costal margin**
- **Intercostal spaces** filled with **intercostal muscles**
- **Costochondral junctions**, where ribs fuse with **costal cartilages**. You may be able to identify these as a change in color—the ribs are often paler than the costal cartilages. The costochondral junctions are an inch or two lateral to the sternum.
- Lateral to the costochondral junctions, identify the **external intercostal muscles**. You will note that the muscles fibers run in an oblique direction inferomedially (like putting your hands in your front pockets). An **external intercostal membrane** (an aponeurosis) replaces the external intercostal muscle between the costochondral junction and the sternum (producing a see-through “window”).
- Adjacent to the sternum (and seen through the external intercostal membrane), identify the **internal intercostal muscles** = fibers run in an oblique direction inferolaterally (at a right angle to the external intercostal muscles).



Thieme, Atlas of Anatomy; Figure 6.10

Figure 8.3.

You will see the **innermost intercostal muscles** when you remove the chest wall from your donor.



COMPLETE ANATOMY

Muscles and structure of the thoracic wall



Remove the anterior thoracic wall from your donor.

We will do this in two steps:

- 1 Cut ribs, sternum, and clavicle with bone cutters and autopsy saw.
- 2 Incise soft tissues, elevate body wall, and remove from the donor.

PREP WORK



Prior to lab, ribs 2–6 were cut for you along the mid-axillary lines. Yay! Thank you, instructors and PAs! The clavicles were cut for you too, at their midpoints.

- 1 With a scalpel, make incisions bilaterally through the 6th intercostal spaces, from the midaxillary lines laterally (where the ribs were cut) to the costal cartilages medially. Don't go too deep—you'll damage the diaphragm or lungs! **See blue lines in Figure 8.4.**
- 2 With an autopsy saw or bone cutters, cut across the costal cartilages and sternum. **See red line in Figure 8.4.**

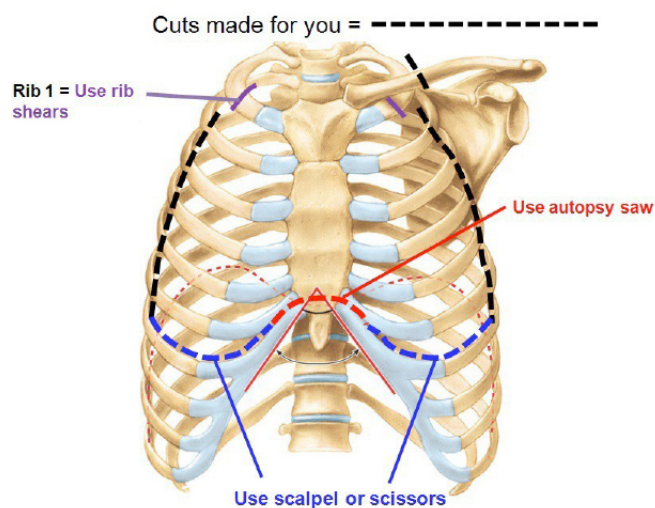


Figure 8.4. Clinically Oriented Anatomy.

NOTE



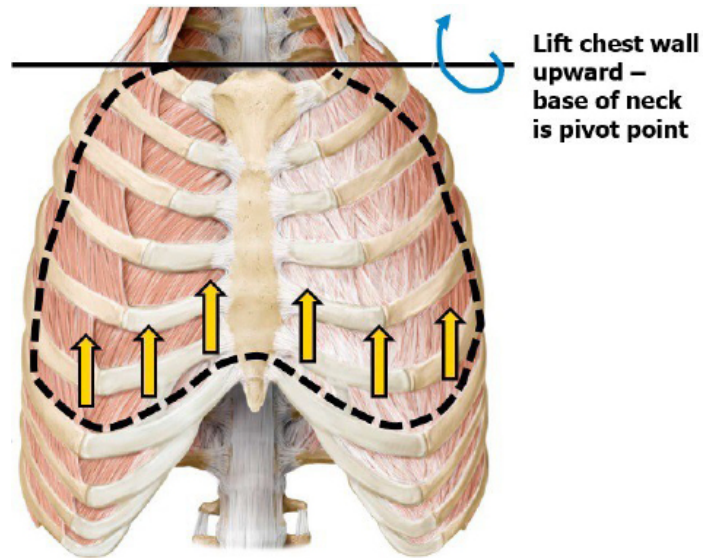
There are a limited number of autopsy saws, so you may need to wait until one of these becomes available, or use the heavy-duty bone cutters.

IF YOUR DONOR HAD A STERNOTOMY,



and there are steel wires in the sternum, **DO NOT USE** the autopsy saw, because the wires will damage the blade. Use the bone cutters instead.

- 3 Have one member of your team begin elevating the anterior thoracic wall from inferior to superior, like lifting the hood of a car. Take care not to enter the peritoneal cavity below.



Gilroy, Atlas of Anatomy, 3rd ed., Fig. 7.10, Illustrator: Wesker/Voll, ©2017 Thieme Medical Publishers, Inc. All Rights Reserved.

Figure 8.5.

- 4 As the chest wall is lifted, another team member will use scissors to cut the soft tissues that are holding it down inside the thoracic cavity, especially the **sternopericardial ligament**. See Figure 8.6.

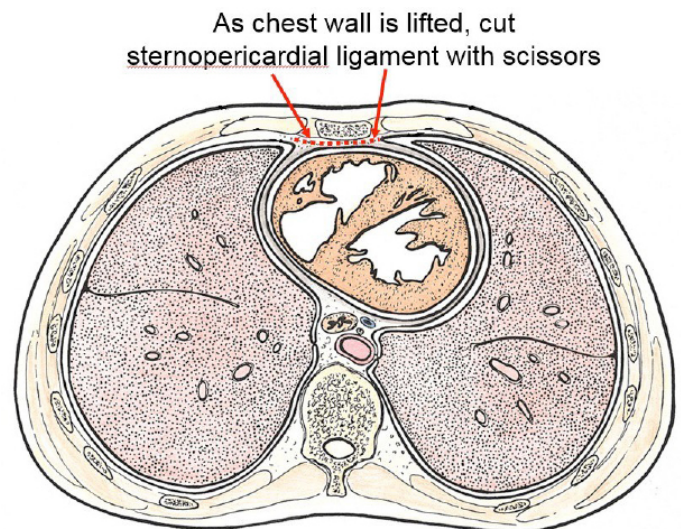


Figure 8.6.

As you lift the anterior chest wall, and if you haven't cut too deep with the saw or scalpel, you might be able to slide a finger between the rib cage and pleura and peel the **costal (parietal) pleura** away from the chest wall as you lift. The costal pleura is the innermost layer of the chest wall and if you can peel it away and leave it draped over the anterior lungs the **pleural sac** will be intact. See [Figure 8.11](#).



TAKE CARE

Rib fragments are sharp!

Once the chest wall is elevated from inferior to superior, the structures preventing its complete detachment are the **first ribs** and **neck muscles** attaching to the superior margins of the sternum and clavicles. You will cut these loose with rib shears, scalpel, and scissors.

- 5 Have a team member lift the chest wall.
Another team member will locate the first rib by palpation, then cut it by sliding a **rib shear** under the rib and squeezing the handles together. You will feel and hear the rib collapse. Do this on both sides. See purple lines in Figure 8.7.

TAP
TO
SEE A
RIB
SHEAR

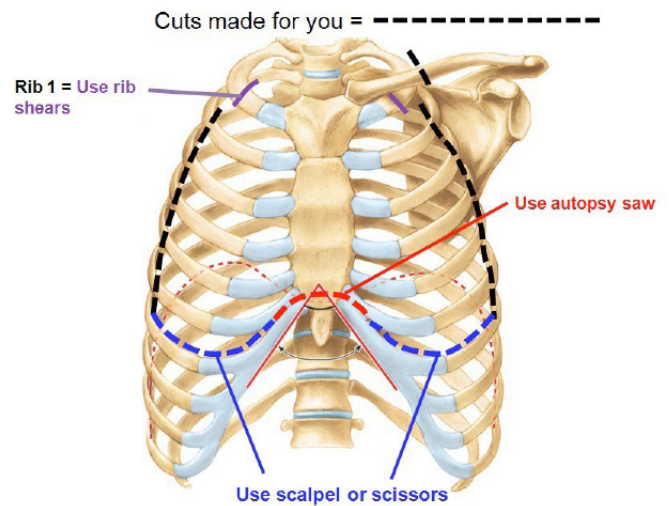


Figure 8.7.

Pause here and consider the course of the **subclavian vessels**. They pass from neck to axilla through the spaces between the first ribs and clavicles. Consider this as you remove the chest wall—we would like to preserve the subclavian vessels for later study. **Which of the vessels is most superficial, and thus right under the clavicle = subclavian artery or vein?**

- 6 Use blunt dissection (fingers) to loosen up the space between first ribs and clavicles, prying away the subclavian vessels from the inferior surface of the clavicles.
- 7 With scissors, cut through the small **subclavius muscle** on both sides located between the clavicle and rib 1. See Figure 8.7.

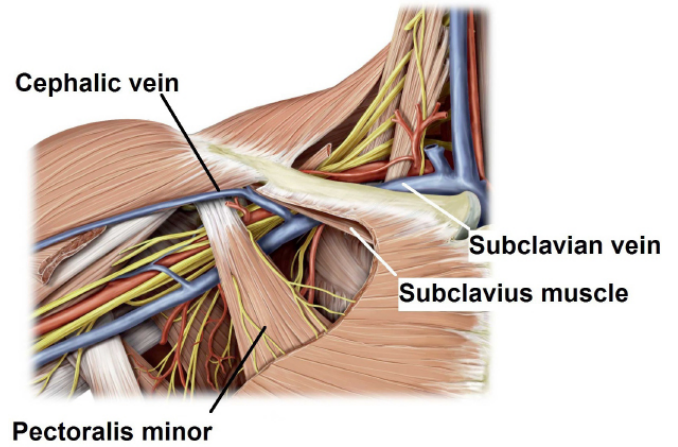


Figure 8.8.

- 8 The last obstacle will be neck muscles attaching to the sternum and clavicles. Use a scalpel to cut the attachments of the **sternocleidomastoid muscles** from the superior border of the clavicles and manubrium. See Figure 8.9.

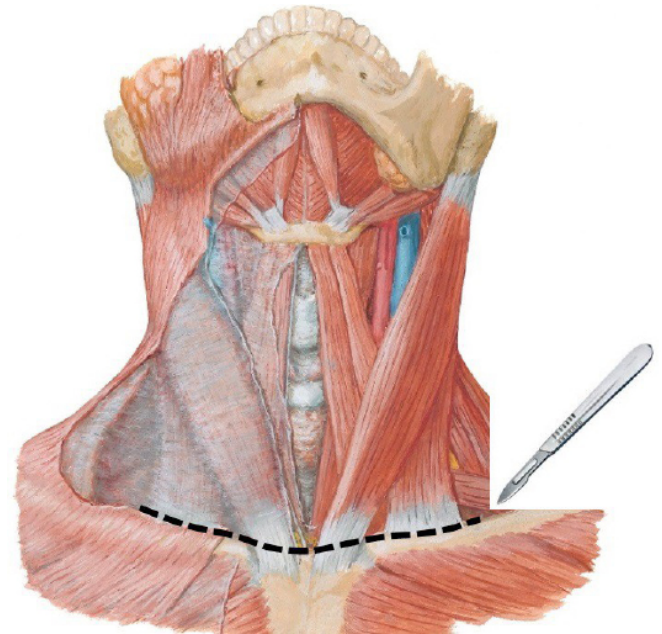


Figure 8.9. Netter, Atlas of Human Anatomy, Plate 27.

- 9 Lift up the chest wall and cut away the **infrahyoid (strap) muscles** from the deep surface of manubrium where they attach. See Figure 8.10. Trim these carefully, as the **cervical pleura** and the **subclavian and brachiocephalic veins** are close by and can be easily damaged.
- 10 Realize that this cutting will transect the **internal thoracic arteries and veins**. **From which arteries do they originate? Where do the veins drain?** The internal thoracic vessels are bilateral and course vertically between the ribs and pleura, just lateral to the sternum. The internal thoracic vessels are shown in Figures 8.11 and 8.12.

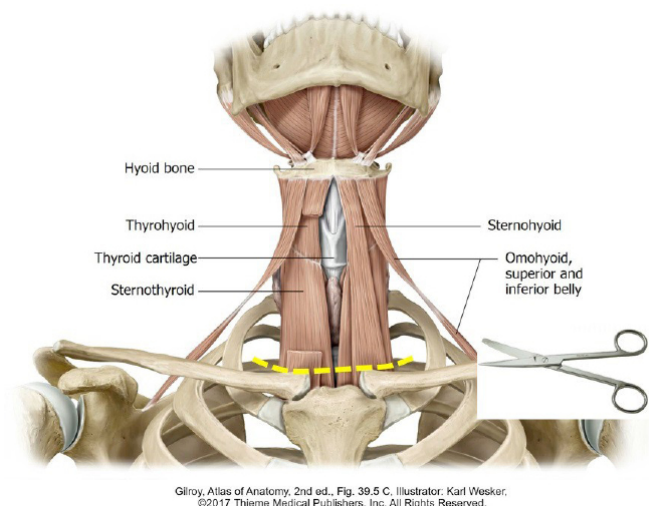


Figure 8.10.

INNER CHEST WALL



Inspect the internal surface of the chest wall.



COMPLETE ANATOMY

Posterior chest wall



COMPLETE ANATOMY

Arteries of the thoracic wall

In an ideal world, the pleural sacs will be left intact after the body wall is removed. That is, the **costal layer of the parietal pleura** would be peeled away from the chest wall and the pleural sac left intact around the lung. The lung would be visible through the costal pleura (see Figure 8.11: a fantasy dissection!).

It is likely, however, that the **costal part of the parietal pleura**, was torn away from the pleural sacs when the anterior chest wall was removed. If this is the case, then the most internal layer of the chest wall you removed will have a shiny appearance and smooth texture.

Turn the removed chest wall over and peel back the most internal layer of tissue to verify that it is the **costal layer of parietal pleura**.

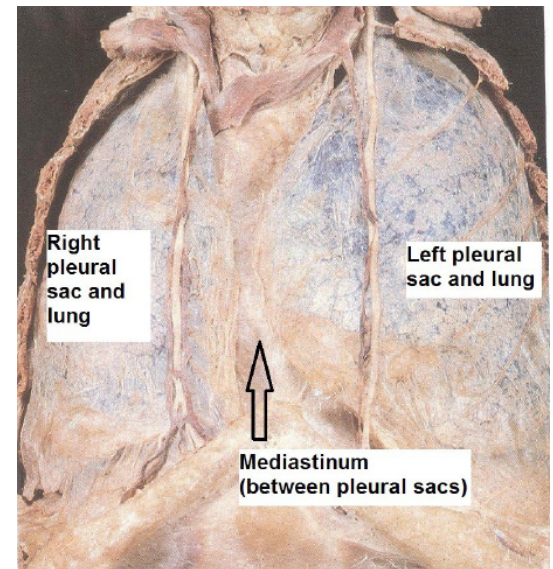


Figure 8.11. The pleural sacs are intact around the lungs and the internal thoracic arteries have been left intact after removal of the chest wall. Nice dissection!! Gosling et al. Atlas of Human Anatomy, Lippincott.

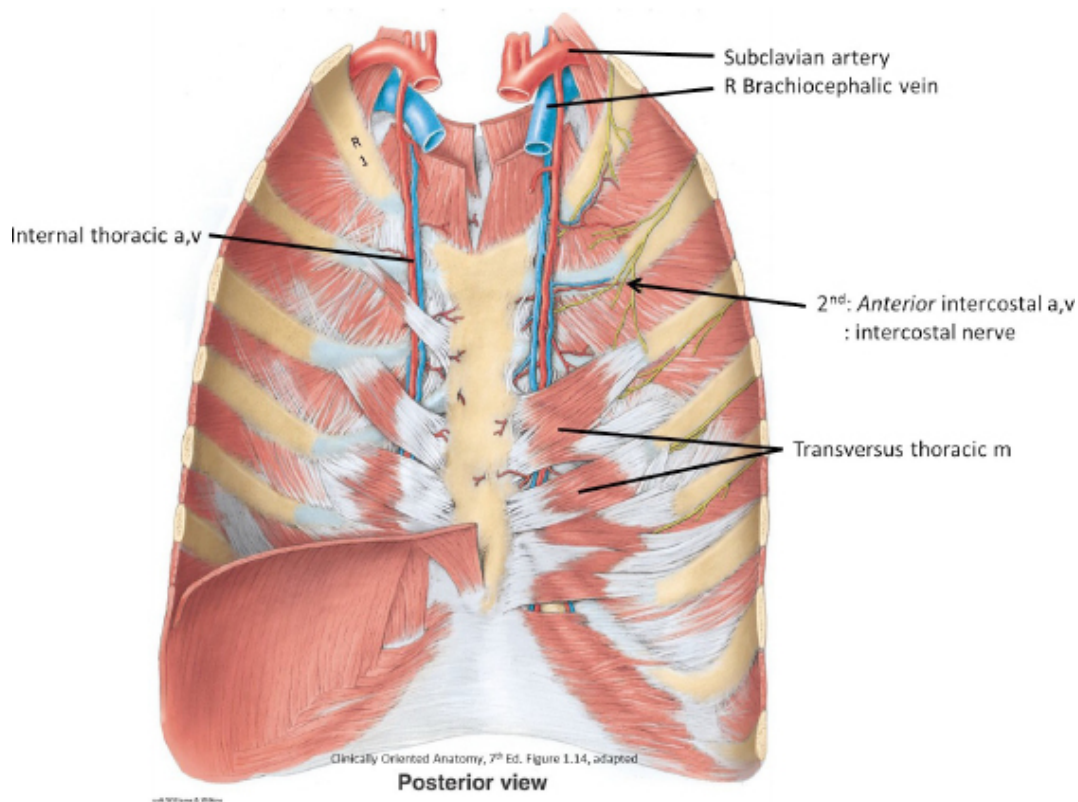


Figure 8.12.

- 1 Now locate the **transversus thoracis** muscles—small oblique muscles running from costal cartilages to sternum. These are part of the innermost muscle layer of the thoracic wall. (See Figure 8.12.)
- 2 Use scissors to cut away the transversus thoracis on one side to reveal the **internal thoracic artery and veins** (the veins are paired). The arteries are branches of the **subclavian arteries**.
- 3 Try to spot the small **anterior intercostal arteries** branching from the internal thoracic artery and entering the intercostal spaces. These anastomose with the **posterior intercostal arteries** (branches of the thoracic aorta) at the midpoint of the intercostal spaces—near the mid-axillary line. See Figure 8.13.

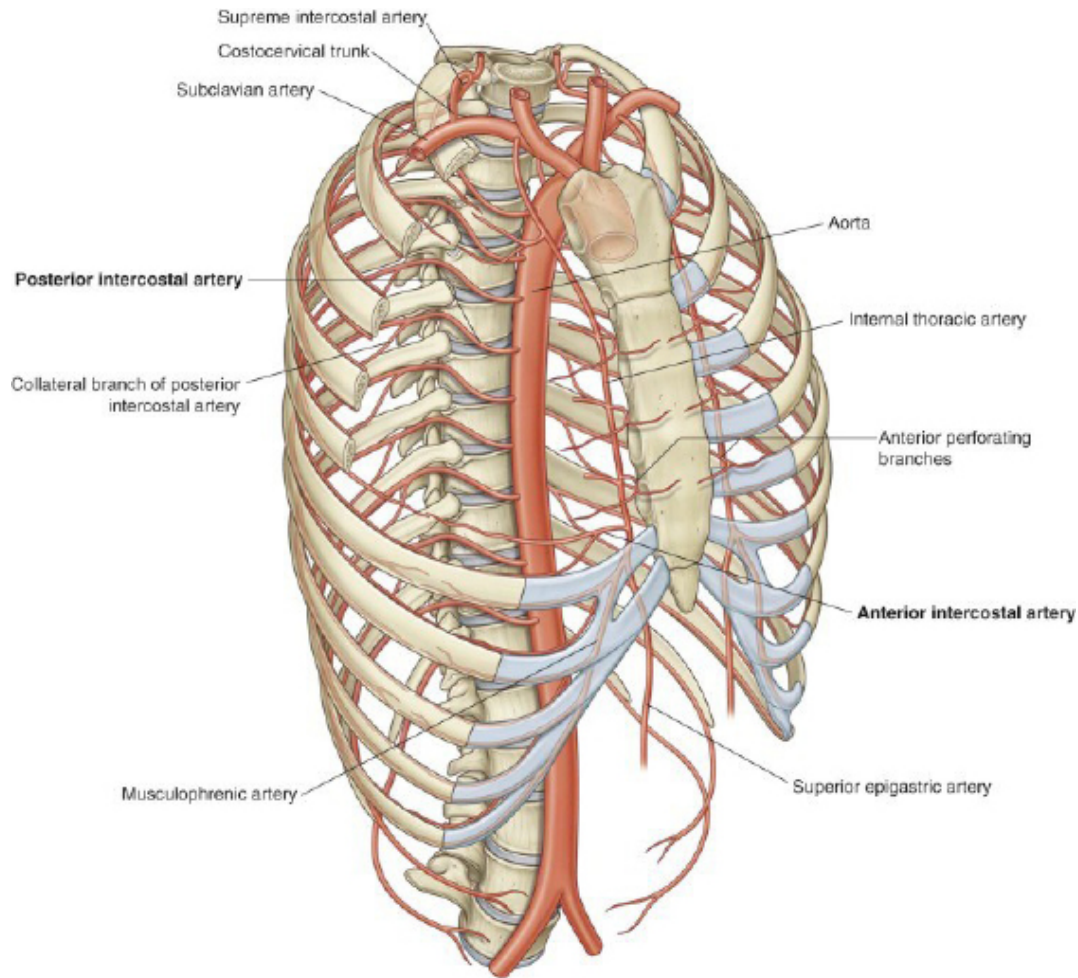


Figure 8.13. Grays Anatomy for Students, 3rd ed.

Discuss:

The **neurovascular plane** of the thoracic body wall is between the 2nd and 3rd muscle layers = between the internal and innermost intercostal muscles. In this plane run the segmentally arranged **intercostal nerves and vessels** of the body wall.

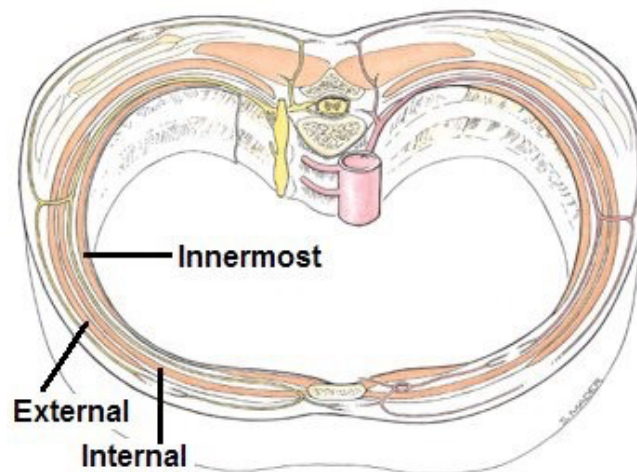


Figure 8.14.

NOTE

Recognize that within an intercostal space, there are two sets of intercostal vessels (**anterior and posterior intercostal veins; anterior and posterior intercostal arteries**) but only one **intercostal nerve**. Anterior and posterior intercostal veins and arteries anastomose (connect) at the midpoint of each intercostal space. The **intercostal nerves** are formed by the ventral rami of thoracic spinal nerves T-1 to T-11. The ventral ramus of T-12 spinal nerve runs below the 12th rib, forming the **subcostal nerve**. Intercostal nerves are mixed nerves.

PLEURAL CAVITIES



COMPLETE ANATOMY

Intercostal space



Explore the pleura and pleural cavities.

Most likely, the anterior part of the **costal pleura from both pleural sacs** has been removed when the chest wall was lifted off the donor. If you are lucky enough to have it intact: use scissors to cut large slits in the costal pleura in order to open both **pleural sacs**.

Most likely, the anterior part of the **costal pleura from both pleural sacs** has been removed when the chest wall was lifted off the donor. If you are lucky enough to have it intact: use scissors to cut large slits in the costal pleura in order to open both **pleural sacs**.

With your hands, explore the **pleural cavities** all the way around the lungs, freeing up any fibrous adhesions that have obliterated parts of the pleural cavities.

These are common in donors and if not removed they can cause lung tissue to be sheared off when the lungs are removed. You don't want to do that.

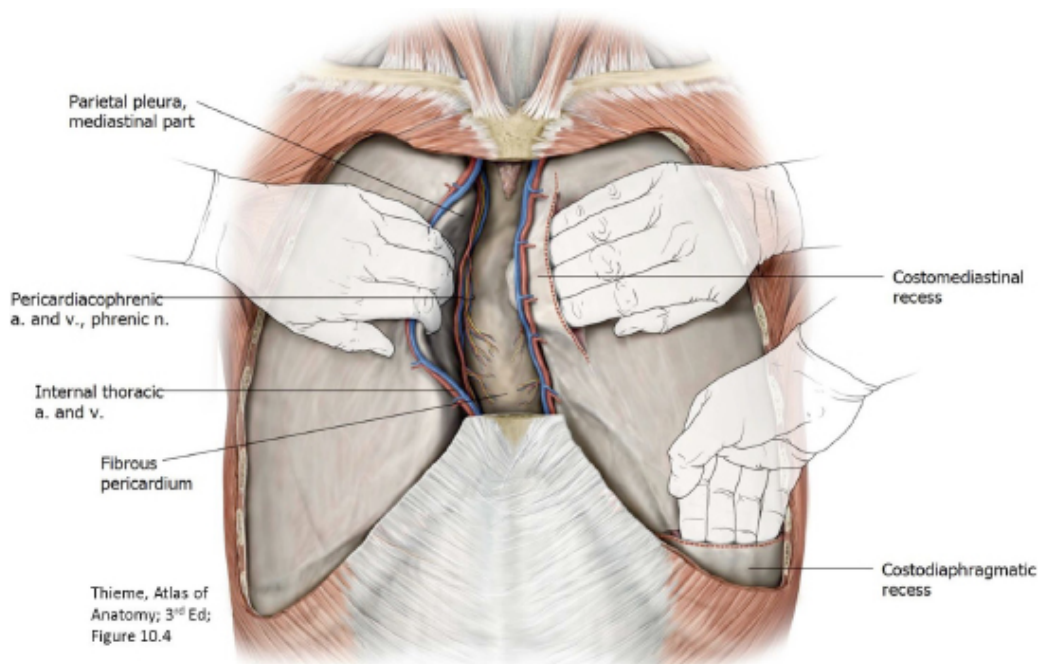


Figure 8.15.



TAKE CARE

Be careful of the sharp edges of the cut ribs.

Realize that your hands are in a potential space between parietal and visceral layers of pleura. The **parietal pleura** is the innermost layer of the body wall while the **visceral pleura** is the outermost layer of the lung itself.

The one area where you won't be able to pass your gloved hand around the lung is medially where the lung faces the mediastinum.

This is where the **root of the lung** is located. The structures that comprise the root of the lung are the **pulmonary arteries**, **pulmonary veins**, and **main bronchi** that travel in/out of the lungs.

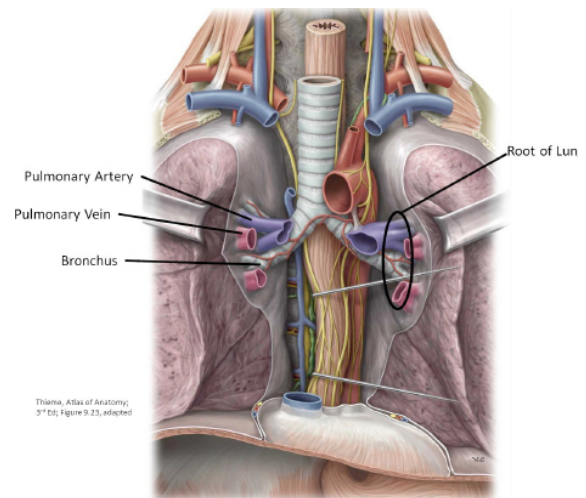


Figure 8.16.

CHALK TALK



Review the parts of a generic serous sac = parietal layer and visceral layer of serous membrane and the serous cavity (potential space) between them. The old 'fist in a balloon' visual analogy! Now apply this generic model specifically to the pleural sacs. What are the layers called? What is the cavity called?

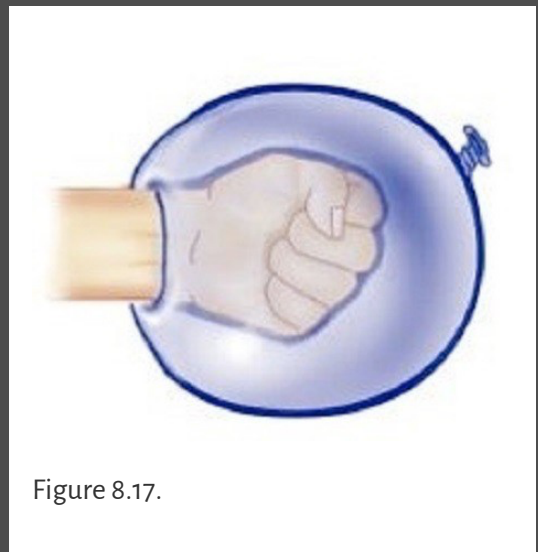


Figure 8.17.

QUESTION



The parietal pleura is associated with the body wall, while visceral pleura is associated with an organ (the lung). Which parts of the nervous system innervate each? How would pain be perceived from each?



Remove BOTH lungs.

- 1 Make sure any adhesions within the right pleural cavity have been removed.
- 2 Before you cut, locate the **phrenic nerves** sandwiched between the mediastinal parietal pleura and the fibrous pericardium. The phrenic nerves arise in the neck from the ventral rami of spinal nerves C-3, C-4, and C-5. They pass anterior to the roots of the lungs as they make their way inferiorly toward the diaphragm.
- 3 Have one of your teammates retract each lung away from the mediastinum, so that the lung root (with its pleural covering) can be seen. Another team member will then use a knife or scalpel to carefully cut through the root of the lung, closer to the lung than the mediastinum. **DON'T CUT THE PHRENIC NERVES.**
- 4 Don't cut through the lung root all at once—cut halfway through, pause to pull the lung forward a bit, and then cut through the remaining root structures. This will help you avoid cutting off the portion of the lung that is behind the lung root.
- 5 After the lung has been freed, lift it out of the thoracic cavity.

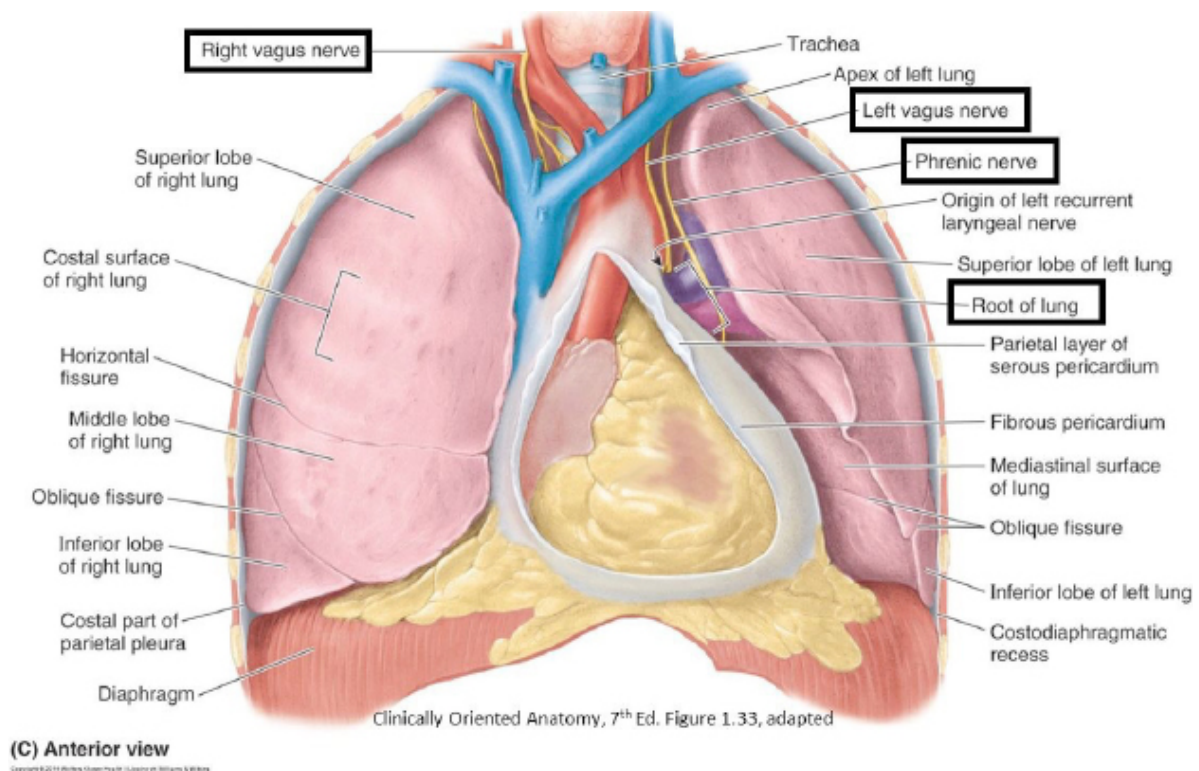


Figure 8.18.



Inspect the extent of the parietal pleura and pleura cavities.



COMPLETE ANATOMY

Pleural spaces

After the lungs have been removed, identify and trace the four named parts of the parietal pleura:

- **Cervical (aka = cupula)**
- **Mediastinal**
- **Diaphragmatic**
- **Costal**

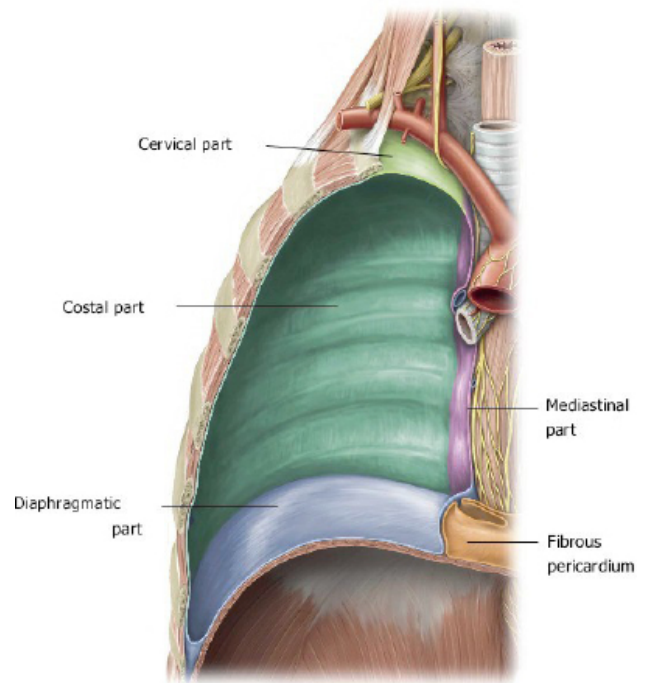


Figure 8.19.

QUESTION



Trace the cervical pleura upwards—note that it extends into the root of the neck. The apex of the lung fits snugly into this region. What is the name of the depression on the surface of the body wall, superior to the clavicle? The cervical pleura and apex of the lung are deep to this landmark. Realize that wounds to the lower neck could therefore enter the pleural cavity and possibly cause a **pneumothorax**!

POSTERIOR THORACIC WALL



Inspect the internal thoracic wall. Remove the costal and mediastinal pleura from the right side.

Use scissors and forceps to cut/strip away the costal and mediastinal pleura from the inner body wall and the mediastinum, respectively. Do this ONLY on the right side. Be careful when stripping off the mediastinal pleura—preserve the **phrenic nerve**.

With the parietal pleura removed, you will see the innermost muscle layer between the ribs. The innermost muscle layer is an incomplete layer—consisting of three named parts:

- 1 At the mid-axillary line, this layer is called the **innermost intercostal muscle**.
- 2 Posteriorly, this layer is called **subcostal muscle (note that muscle fibers of the subcostal portion span more than one intercostal space)**.
- 3 The anterior-most part of this muscle layer consists of the **transversus thoracis muscles** (you saw these on the inside of the chest wall that you removed earlier).

In a couple of intercostal spaces, just lateral to the vertebral column, look for the **neurovascular bundle** (vessels and nerve) that course along the inferior border of the rib that is above the space. Each neurovascular bundle consists of a **V**ein, **A**rtery, and **N**erve. Follow the bundles laterally until they disappear behind the innermost muscle layer to pass into the **neurovascular plane** of the body wall (between 2nd and 3rd layers of muscle).

In the neurovascular plane, coursing along the inferior border of a rib (in the **costal groove** of the rib), neurovascular structures are arranged from top to bottom:

- Intercostal **V**ein
- Intercostal **A**rtery
- Intercostal **N**erve

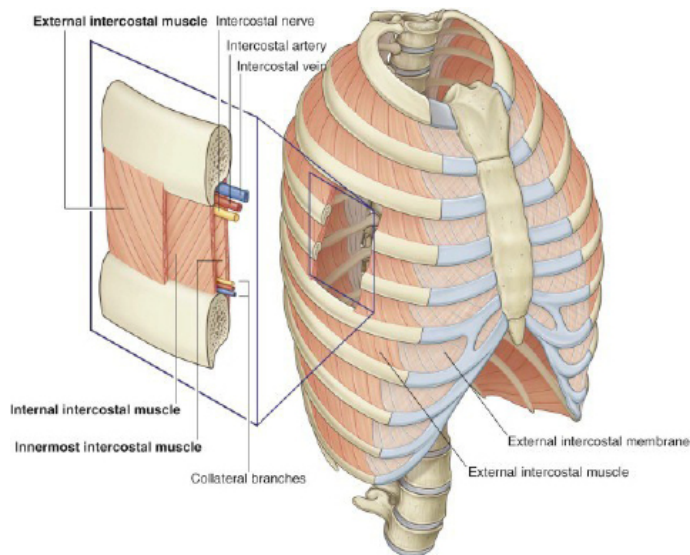


Figure 8.20. Gray's Anatomy for Students, 3rd ed.

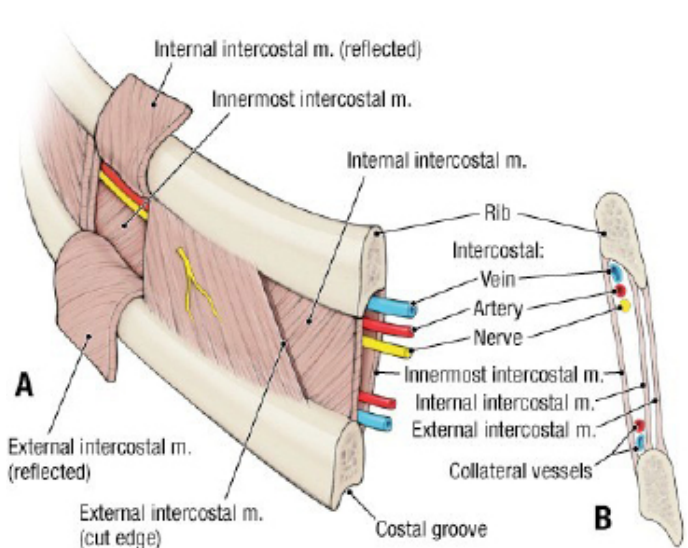


Figure 8.21.

REVIEW: There are two sets of intercostal arteries and veins supplying an intercostal space:

- **Posterior intercostal arteries/veins**
- **Anterior intercostal arteries/veins**

Make sure the parietal pleura has been removed from the right side of the spine and mediastinum. Identify the large **azygos vein** ascending along the vertebral column and draining into the superior vena cava. The right posterior intercostal veins drain into the azygos vein.



QUESTION

Where do each of the intercostal arteries originate?



QUESTION

Where do each of the intercostal veins drain?



QUESTION

Where do the intercostal nerves originate?



COMPLETE ANATOMY

Veins of the thoracic wall

CHECKLIST, LAB #8

REVIEW AND MAKE SURE YOU HAVE IDENTIFIED EACH OF THE STRUCTURES BELOW.

CHEST WALL

- Sternum: body, manubrium, and xiphoid
- Ribs, costal cartilages, and costal margin
- External and internal intercostal muscles
- Innermost intercostal muscles
- Internal thoracic artery and veins
- One example of an anterior intercostal artery

PLEURA/PLEURA CAVITIES

- Parietal pleura
 - Costal
 - Cervical (cupula)
 - Mediastinal
 - Diaphragmatic
- Visceral pleura
- Pleural cavity

OTHER

- Azygos vein (in the posterior mediastinum)
- Posterior intercostal artery and vein and Intercostal nerve (in an intercostal space)
- Right phrenic nerve