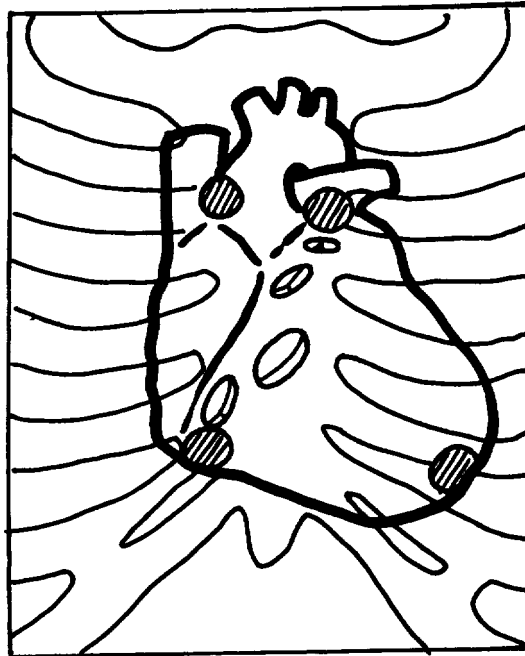
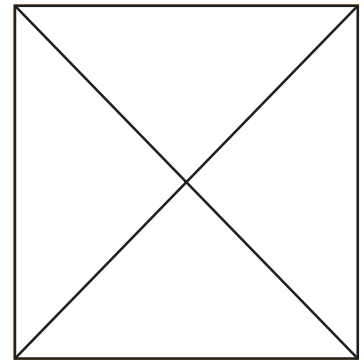


Functional Human
Morphology (2040)

&

Functional Anatomy of
the Head, Neck and Trunk (2130)



Respiratory

&

Cardiovascular Systems

Recommended Text:

TEXTBOOK OF ANATOMY: ROGERS

Published by Churchill Livingstone (1992)

HUMB2040/THOR/SHP/97

Practical class 1

THORACIC WALL DIAPHRAGM AND PLEURA

OBJECTIVES

By the time you have completed this practical, and any necessary further reading or study, you should be able to:

1. Define the terms internal and external respiration.
2. Describe and identify the characteristics of a typical thoracic vertebra, a typical rib and the sternum.
3. Describe how the ribs articulate with the vertebrae and the sternum, and understand the movements which occur at these joints
4. Describe the arrangement and relations of the muscle layers, intercostal membranes, vessels and nerves in a typical intercostal space. Identify these structures in appropriate prosections and understand their functions
5. Outline the structure of the diaphragm and describe its role in respiration.
6. Discuss the mechanisms of respiration.
7. Define the term pleura and explain the relationship between the visceral and parietal pleura.
- 8 Describe the boundaries of the pleural cavities.
9. Explain what is meant by the costodiaphragmatic recess and understand its functional importance
10. Define the term mediastinum

Background reading

Rogers: Chapter 6; The respiratory system

35; The lungs and pleural cavities

36; The mechanisms of respiration

INTRODUCTION

What is meant by: internal (cellular) respiration?

external respiration?

The respiratory system is concerned with the process of external respiration.

Give two other functions of the respiratory system.

Since becoming land based multicellular organisms, it is no longer possible for us to rely on simple diffusion through the skin for our respiratory needs. Instead we have developed a specialised respiratory system. This essentially consists of three parts: a moist internal surface for gaseous exchange (the lungs), a system of tubes to transport, warm and air condition air (trachea and bronchi) and a mechanism which allows filling and emptying of the lungs (thoracic wall and diaphragm).

In today's class you will study all of these aspects. First you should consider the structure of the thoracic wall.

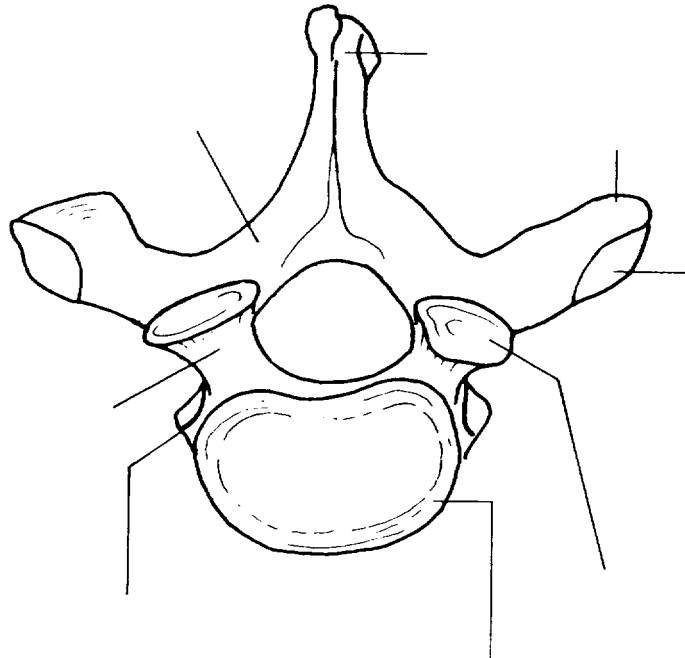
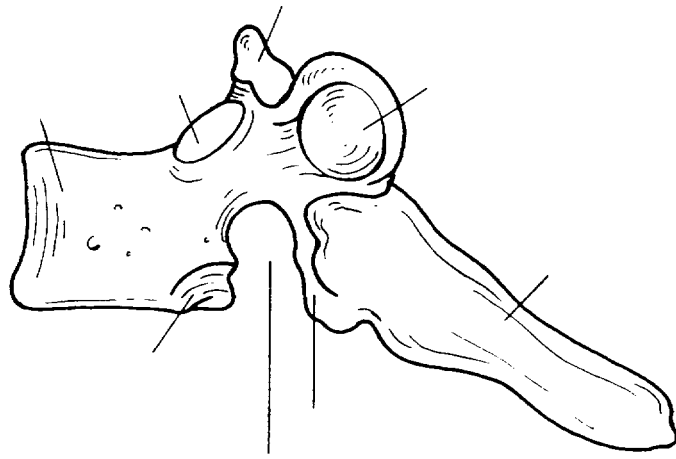
OSTEOLOGY OF THE CHEST WALL

During inspiration, thoracic volume is increased. This reduces the pressure within the chest below atmospheric pressure and produces a flow of air into the lungs. You should study the structures which make up the chest wall and consider the mechanisms responsible for the changes in thoracic volume during breathing.

Examine the vertebrae provided, and determine which is a typical thoracic vertebra. Identify:

- body of vertebra**
- transverse and spinous processes**
- inferior and superior articular facets**
- upper and lower demifacets for head of rib**
- facet for tubercle of rib**
- lamina**
- pedicle**

Then label these structures on the following diagrams of a typical thoracic vertebra.



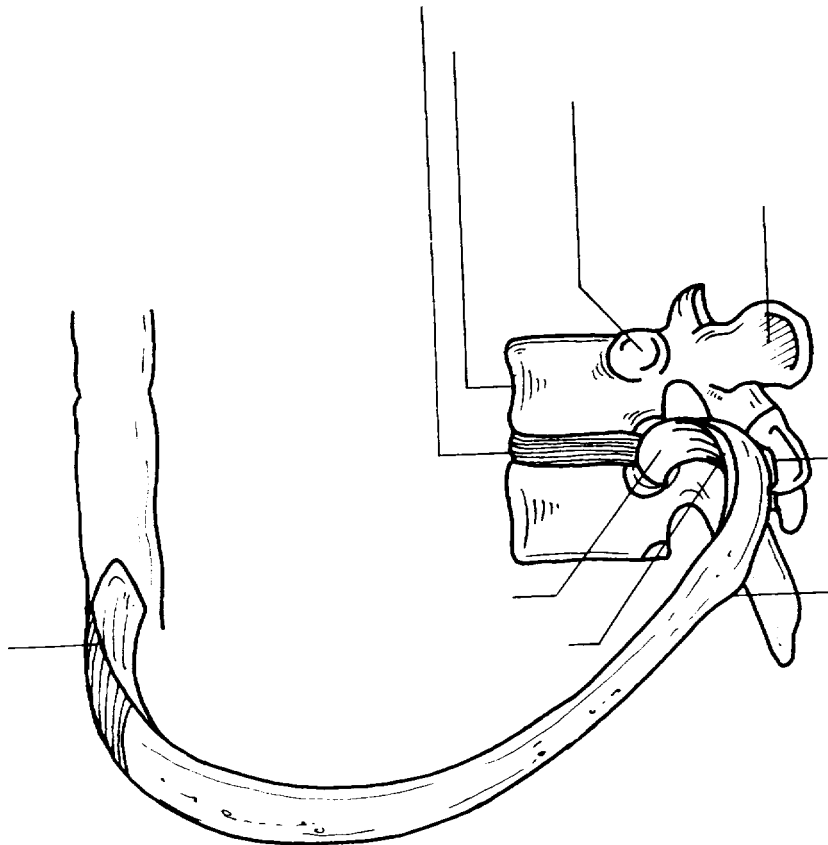
Now examine a “typical” rib i.e. one from the mid-thoracic region and identify the following features:

head **angle**
neck **shaft**
tubercle **subcostal groove**

Label these features on the following diagram of an articulated rib

Articulate a “typical” rib with two “typical” thoracic vertebrae.

Complete the labelling of the following diagram to indicate the articulations of the rib with the adjacent vertebrae.



List those ribs with atypical articulations, and explain how they are atypical.

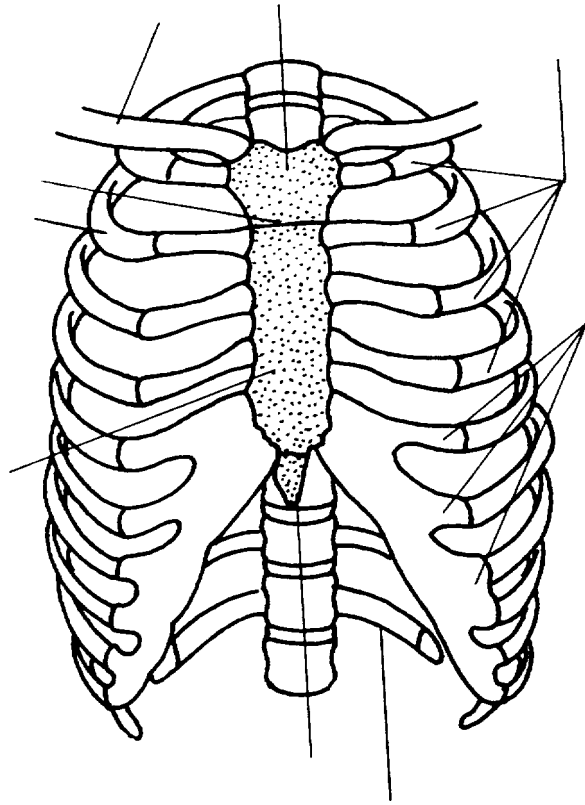
At their anterior ends the ribs are continuous with the hyaline costal cartilages.

Which costal cartilages articulate with: the sternum?

the costal cartilage above?

Why are costal cartilages made of cartilage rather than bone?

Examine the thoracic cage of an articulated skeleton and then complete the labelling of the following diagram of the bony thoracic cage.



What are the major functions of the bony thoracic cage?

At what angle do the ribs articulate with the vertebral column?

What is the functional significance of this angle?

Which is the lowest rib to form part of the costal margin?

INTERCOSTAL SPACES

There are 11 intercostal spaces, which lie between the 12 pairs of ribs. These share a common structural pattern.

Look at a prosection which has been dissected to show the various layers of intercostal muscle which occupy the intercostal spaces.

Identify the external, internal and innermost intercostal muscles, label these on the following diagram.



In which direction do the fibres of the external intercostal muscle run?

In which direction do the fibres of the internal intercostal muscles run?

What would you observe if the muscles in one intercostal space were paralysed?

The vein, artery and nerve supplying the intercostal space lie in that order (V.A.N.) just under the lower border of the rib above in the **subcostal groove**. Identify these structures in prosected specimen. (They can be located most readily if you examine the chest wall from its internal aspect)

Locate and label these on the previous diagram.

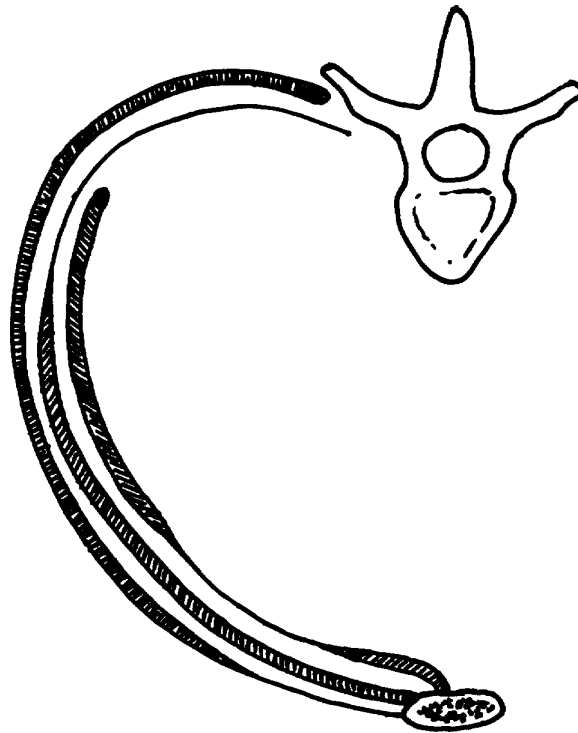
Between which muscle layers does the neurovascular bundle lie?

Considering these facts, how then should a chest drain be placed through the intercostal space?

The following diagram shows an illustration of the muscle layers in one half of a section of the thorax through a typical intercostal space. Note that this section is in the plane of the ribs and not a true cross section.

Label the three muscle layers shown.

Note that both external and internal intercostal muscle layers give way to membrane for part of their course, and that the innermost layer is incomplete.



Sketch the arrangement and distribution of an intercostal nerve onto the diagram.

What structures does each intercostal nerve supply?

THE DIAPHRAGM

The diaphragm is a large domed sheet of skeletal muscle which forms the floor of the thoracic cavity. Its muscle fibres insert into a large **central tendon** which lies high in the thorax, at about the level of the 8th thoracic vertebra. The superior aspect of the central tendon is fused to the **fibrous pericardium**, the tough fibrous protective layer which surrounds the heart. Identify this in the prosection.

Where do the muscle fibres of the diaphragm take origin?

Identify also the **phrenic nerves** which provide the sole motor supply to the diaphragm. These nerves originate from branches of cervical spinal nerves (C3 to C5) then run down from the neck and through the thorax to reach the diaphragm. If you have difficulty locating these nerves, ask a demonstrator for help.

The diaphragm is the principle muscle of respiration.

*What effect would contraction of the muscles of the diaphragm have on:
the shape of the diaphragm?*

the volume of the thorax?

the contents of the abdomen?

RESPIRATORY MOVEMENTS

Now that we have observed the structures responsible for respiratory movements, consider the mechanisms which lead to the changes in thoracic volume occurring during inspiration and expiration.

The following changes in thoracic dimensions were observed in a healthy, adult male during deep and quiet inspiration:

	Increase in transverse diameter		Increase in Ant-Post diameter	
	Deep inspiration	Quiet inspiration	Deep inspiration	Quiet inspiration
Upper chest	45mm	10mm	15mm	3mm
Lower chest	25mm	4mm	10mm	1mm

Describe the differences: between the upper and lower chest.

between deep and quiet inspiration.

How is the increase in the antero-posterior diameter of the thorax during inspiration brought about?

*How is the increase in the transverse diameter of the thorax during inspiration brought about:
in the upper chest?*

in the lower chest?

Increase in the vertical height of the chest also plays a major part in inspiration.

How is this increase brought about?

Which area of the lung do you think is principally ventilated in quiet inspiration?

What mechanisms are responsible for the decrease in thoracic volume occurring during expiration?

Certain disease conditions, such as emphysema and cystic fibrosis, involve progressive loss of the elastic tissue of the lung.

What effect will this have on respiration?

The accessory muscles of respiration are skeletal muscles which assist breathing during forced ventilation.

Name at least four such muscles, and comment on how they are able to assist ventilation.

- 1)
- 2)
- 3)
- 4)

Now attempt to summarise to a colleague the mechanisms involved in quiet and deep respiration. If you are unsure, ask a tutor.

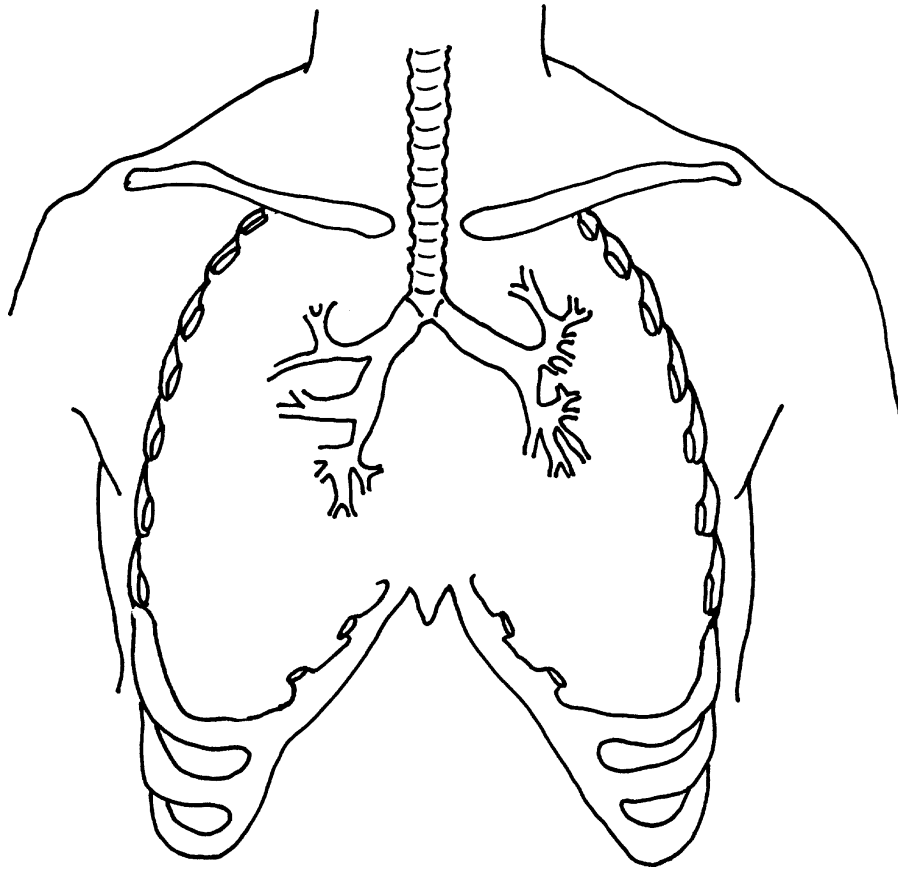
THE PLEURA

The pleura are a double layered serous membrane which cover the lungs and line the thoracic walls, producing two chambers, one to either side of the mediastinum.

What is the mediastinum?

Consider the following 'cut-away' diagram of the thoracic wall.

Accurately draw the extent and location of the lungs and pleural cavities onto the diagram.



Examine the prosection that has been prepared by removing the anterior chest wall and the anterior part of the **parietal pleura** on each side. Investigate the extent of the **pleural cavity** around each lung. Place the flat of your hand on the surface of the lung and slide your fingers first medially then upwards, laterally and posteriorly in turn. Note that the pleural cavity extends into the recesses anteriorly near the mediastinum, posteriorly and laterally near the diaphragm and superiorly above the first rib. Confirm that the only attachment of the lung is at the **lung root**.

In life, what normally occupies the pleural cavity?

Label the costodiaphragmatic recesses on the previous diagram.

What is the functional significance of these structures?

Both the pleural cavity and the apex of the lung extend above the thoracic inlet i.e. they extend outside the protective bony cage of the thorax. They are therefore vulnerable to injury by penetrating wounds to the neck, such as stab wounds.

What would be the consequences of such an injury?

Review this class and ensure that you can address the objectives set out at the beginning of the section.