

Practical class 2

LARYNX, BRONCHIAL TREE AND LUNGS

By the time you have completed this part of the class and any necessary further reading or study you should be able to:-

1. List in order the major passages and structures through which inspired air would pass from the larynx to the alveoli of the lungs
2. Identify the anatomical features of the larynx associated with sound production and respiration and describe their functioning
3. Identify the component parts of the bronchial tree and understand their function in air conditioning and transport.
4. Define the major gross features of the left and right lungs and differentiate between the two
5. List the structures passing through the root of each lung. Know their relative positions and their function.
6. Outline the nerve supply to the bronchi and lungs.

LIVING ANATOMY OF THE RESPIRATORY SYSTEM

OBJECTIVES

After completing this part of the class and any further necessary study you should be able to:

1. Demonstrate the following landmarks on a living subject:
laryngeal prominence, jugular notch, sternal angle, position of trachea
2. Demonstrate the surface markings of the pleura, lungs and lung fissures on a living subject.
3. Demonstrate the following landmarks on appropriate radiographs:
jugular notch, medial end of clavicle, sternal angle, ribs, diaphragm
4. List the major differences between radiographs taken in inspiration and expiration
5. On appropriate radiographs, identify the trachea, lungs, lung roots and diaphragm.

Background reading

Rogers: Chapter 6; The respiratory system
34; The larynx and trachea

INTRODUCTION

You have already considered the thoracic cage and pleura, in today's class you will look at the larynx, bronchial tree and lungs.

The larynx is important in the prevention of food from entering the lower respiratory tract and phonation (speech).

Identify the epiglottis curling up behind the tongue. Two folds of mucous membrane, the aryepiglottic folds extend from the sides of the epiglottis downwards and backwards to the paired arytenoid cartilages of the larynx. In swallowing, the two folds come towards the midline protecting the laryngeal inlet while food/fluid passes into the oesophagus down the channels lying lateral to these folds.

Where are the piriform fossae?

Which regions of the respiratory tract are "closed off" during swallowing?

Which structures are involved in this transient closing of the respiratory tract?

LARYNX

The larynx is the entrance to the lower respiratory system, connecting the **laryngopharynx** to the trachea.

Give two functions of the larynx.

To understand how the larynx carries out these functions, you should be familiar with the cartilaginous skeleton of the larynx, the actions of the laryngeal muscles and the arrangement of its mucosal folds.

The larynx is made up of five main cartilages:

thyroid cartilage

cricoid cartilage

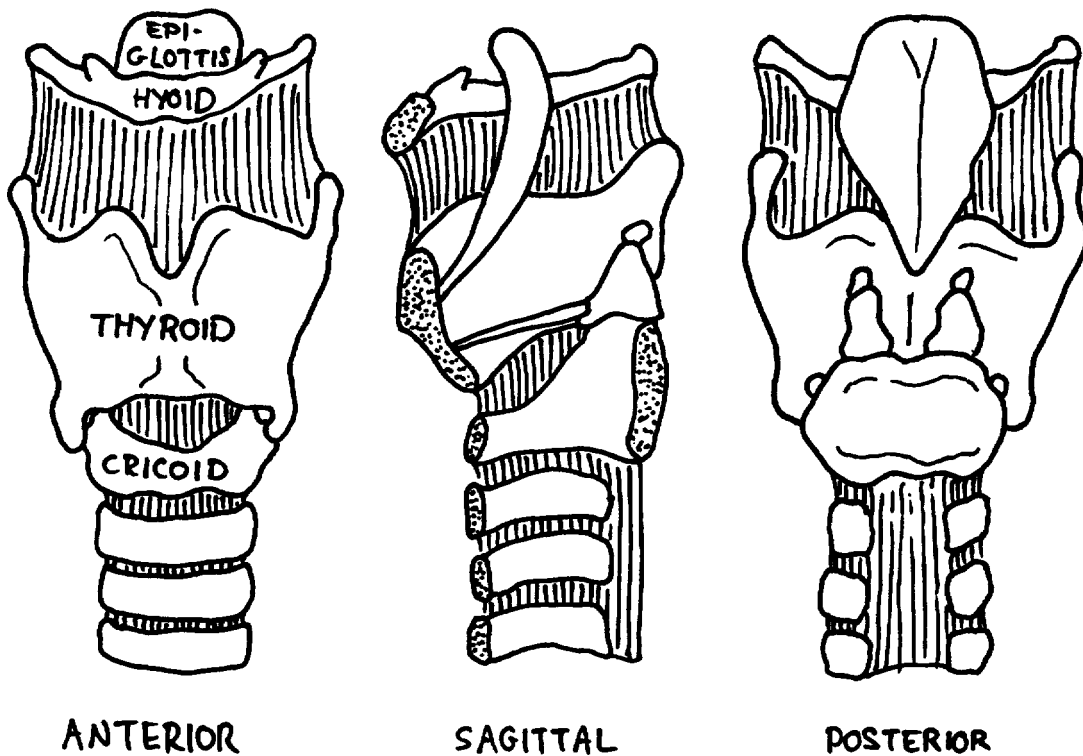
epiglottis

paired arytenoid cartilages

The cartilages articulate by synovial joints.

Use the models to examine the range of movements at these joints.

Label these on the three schematic views of the larynx below.

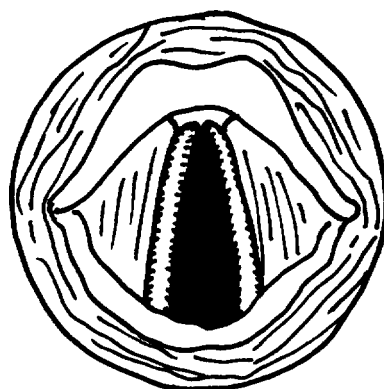


Two pairs of mucosal folds stretch across the cavity of the larynx from the **thyroid** cartilage anteriorly to the paired **arytenoid** cartilages posteriorly. These are the **vestibular** folds and the vocal folds. Like the **aryepiglottic** folds, both pairs can be approximated in the midline to close off the airway.

Identify the: following on the medial aspect of a bisected head.

- aryepiglottic fold**
- vestibular fold**
- vocal fold**

Label these structures on the diagram below which shows the membranous folds of the larynx from above (as seen by a laryngoscope).



Which pair of folds is used in sound production?

Tensing the folds in the airstream during expiration causes them to vibrate, producing sound. Pitch is controlled by altering the length and tension of the folds, loudness by the force of the air passed over them.

Why do adult males usually have deeper voices than females?

On a model identify the intrinsic muscles of the larynx - these alter the position of the laryngeal cartilages relative to each other or directly control the position of the laryngeal folds. Read an account of these muscles.

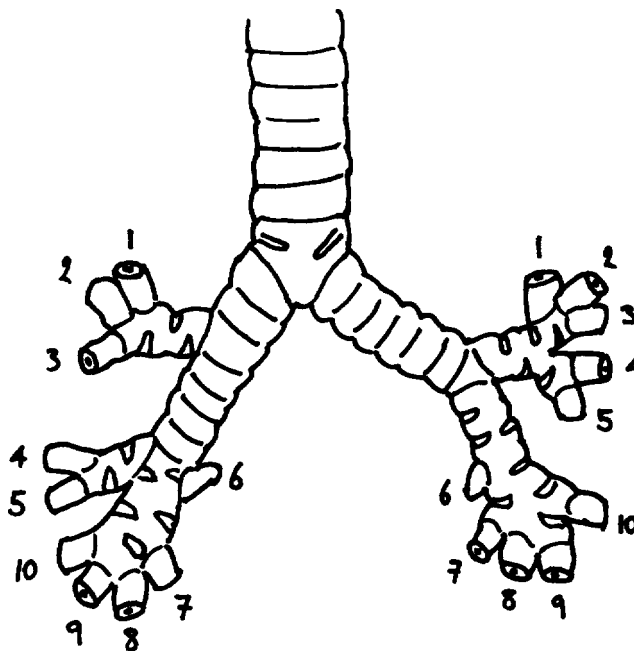
Sounds originate in the larynx, but other structures are necessary to convert sound to recognisable speech.

Name four such structures.

TRACHEA, BRONCHI AND LUNGS

On the following diagram:

Colour the primary, secondary and tertiary bronchi red, blue and green respectively.



Note that the right lung has three secondary bronchi and the left only two.

Label these;

superior, middle and inferior on the right
superior and inferior on the left.

Also note that each lung has the same number of **bronchopulmonary segments**: 10. These are the functional units of the lung and of considerable clinical relevance.

Identify the **trachea** in a prosection of the superior mediastinum. Its characteristic C-shaped bars of cartilage make it readily identifiable as it descends anterior to the oesophagus and posterior to the arch of the aorta. At the level of the sternal angle the trachea bifurcates to form the right and left main bronchi. Try to locate this bifurcation and trace the bronchi towards their respective lung roots.

At what vertebral level is this bifurcation located?

Study the cast of the trachea and bronchial tree. Notice that the **right main bronchus** is wider, shorter and more vertical than the left. This accounts for the greater tendency of foreign bodies (e.g. peanuts, an extracted tooth) and aspirated material (e.g. vomit) to enter the right bronchus rather than the left.

In which part of the right bronchial tree is a peanut inhaled by a child whilst running likely to lodge?

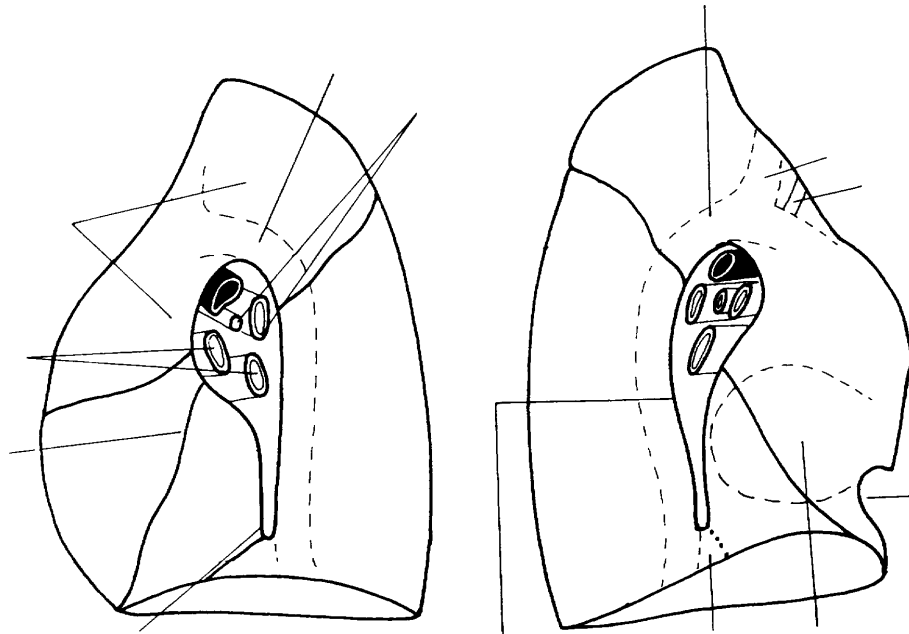
Examine the lungs in situ, then remove them from their respective pleural cavities. Identify the features in **bold** in the following description:

Each lung has a blunt **apex**, concave **diaphragmatic** and **mediastinal** surfaces and a convex **costal** surface. In both lungs there is an **oblique** fissure separating upper and lower lobes. In the right, there is also a **transverse** fissure which, with the **oblique** fissure, demarcates the middle lobe. Each lobe is further subdivided into bronchopulmonary segments based on the divisions of the bronchi which supply them.

Sketch medial views of the left and right lung in the space below. Label the fissures and lobes discussed above.

Study a prosection in which the lungs have been severed at their roots and the parietal pleura has been stripped from the lateral faces of the mediastinum and the adjacent posterior body wall. Prosections of the L & R lungs partially dissected to show bronchi are also available.

Label the following schematic diagram of the lung roots as viewed from the medial surface.



Summarise the differences between the two lung roots.

What other structures pass through the root of the lung?

Search the lung root for the **hilar lymph nodes**, which usually appear black or dark grey. Lymphatic vessels from the lung substance drain to these nodes, which in turn drain to nodes around the bifurcation of the trachea (**tracheo-bronchial nodes**). Enlargement of the nodes due to infection or carcinoma may cause obstruction of a bronchus.

What effect would this have on the lung?

Which vessels provide the lungs and bronchi with their blood supply?

The nerve supply to the bronchi and lungs comes from the **pulmonary plexus** of autonomic nerve fibres. This plexus lies anterior and posterior to the roots of the lungs, receiving parasympathetic input from the **vagus nerves** as they descend through the thorax and sympathetic input from the thoracic **sympathetic chain**.

What are the actions of the sympathetic and parasympathetic fibres on the lungs and bronchi?

Try to identify the fibres of the pulmonary plexus around the lung roots then examine the lateral surfaces of the mediastinum to locate the vagus nerves and sympathetic chains.

Locate the following on the prosections, and be aware of their relationships to the organs of the respiratory system.

fibrous pericardium
left and right phrenic nerves
aortic arch, descending aorta, ascending aorta
left and right vagus nerves
left recurrent laryngeal nerve
superior and inferior vena cavae
oesophagus
sympathetic chain

What possible connection is there between loss of voice and an intrathoracic tumour?

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

LIVING ANATOMY OF THE RESPIRATORY SYSTEM

In this second part of today's class, we aim of the class is to study the surface landmarks of the respiratory system and to observe it functioning. As many of you as possible should come prepared to act as subjects for this study.

THE LARYNX

By sight and palpation, identify the **laryngeal prominence** (Adam's apple) on your partner's neck. Explore by gentle palpation the other parts of the **thyroid cartilage**: the notch in the superior border, and the **laminae**. Follow the anterior border of the thyroid cartilage downward in the midline until you feel the convex anterior part of the **cricoid cartilage**. Below the cricoid cartilage (in the interval above the jugular notch of the manubrium) can be felt the first couple of rings of tracheal cartilage.

Place a finger on your partner's trachea in the sternal notch and ask them to say 'aaaargh'. You should be able to feel air vibrating in the trachea. If the trachea should become occluded, it may be opened directly through the skin of the neck to produce a surgical airway. This procedure is termed a tracheostomy.

Where in the neck would a surgical tracheostomy be carried out?

Where in the neck would an emergency tracheostomy be carried out?

THE THORACIC WALL

Observe the thorax from anterior and posterior aspects. It should be roughly symmetrical with symmetrical respiratory movements.

Palpate the **jugular notch** of the **manubrium**, which lies between the medial ends of the **clavicles**.

Palpate also the anterior surface of the **sternum** and identify the blunt horizontal ridge forming the **sternal angle**. This is an important landmark - it marks the level of commencement of the aortic arch from the ascending aorta and the level of the tracheal bifurcation.

At what level does the horizontal plane through the sternal angle transect the vertebral column?

How is the sternal angle useful when counting ribs?

Thoracic volume increases in transverse, antero-posterior and vertical diameters in deep inspiration. Observe the increase in transverse diameter. The examiner should stand facing the subject and place his/her hands round the subject's upper chest (i.e. at the level of the axilla) so that the thumbs just touch in the midline at the end of expiration. Watch how the thumbs separate in deep inspiration. Repeat the procedure for quiet respiration.

PLEURAL MARKINGS

The **parietal pleura** lines the pleural cavity and is firmly attached to the inside of the chest wall, the superior surface of the diaphragm and the lateral aspects of the **mediastinum**. Take turns to mark the lines of pleural reflexion (ie. where the parietal pleura is reflected from the inner surface of the chest wall to form the **diaphragmatic** and **mediastinal pleura**) using the washable pens provided.

On both sides, mark the **apex** or **cupola** of the pleura about 2-3cm above the medial 1/3 of the clavicle. From here trace the anterior **pleural margins** down to meet in the midline at the level of the 2nd costal cartilage (ie. the sternal angle).

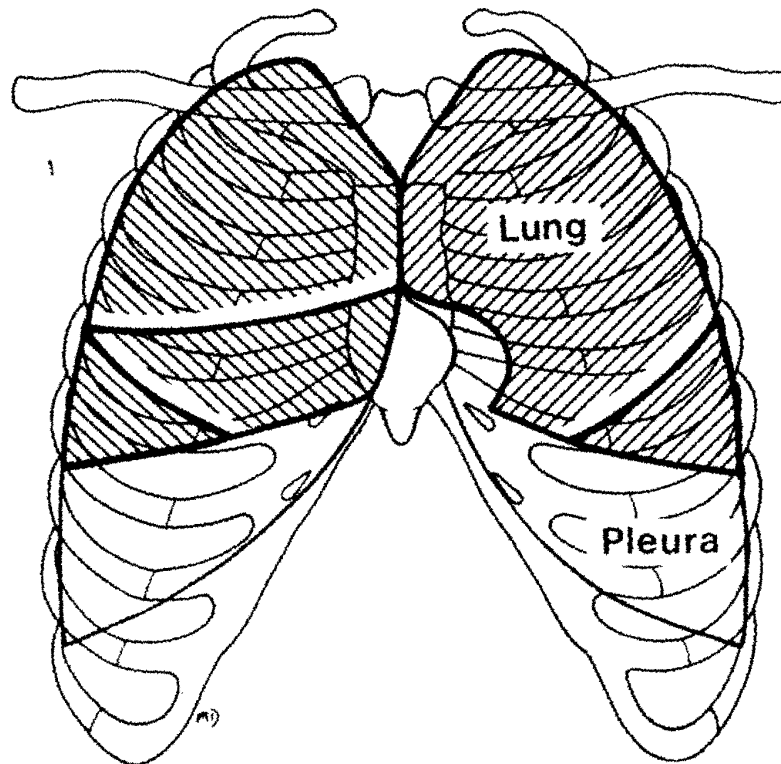
The two margins then pass vertically down behind the sternum to the level of the 4th costal cartilage and then pass vertically down behind the sternum to the level of the 4th costal cartilage.

Here the right pleura continues vertically downwards while the left pleura arches away from the midline to descend just lateral to the sternal margin. Both turn laterally at the 6th costal cartilage.

Continue tracing the margins around the chest wall, crossing the 8th costal cartilage in the mid-clavicular line, the 10th rib in the mid-axillary line and the 12th rib 2-3cm lateral to the mid-line.

The margins then pass horizontally to the lateral border of vertebra T12 where they ascend more or less vertically to the cupolae.

Compare the picture you have produced with the following diagram.



LUNG MARKINGS

Now mark the borders of the lungs on your subject. The markings described are those of mid-inspiration. Remember that they will be more extensive at full inspiration and smaller at full expiration.

The border of the right lung lies immediately inside the pleural margin from the cupola down to about the 6th costal cartilages. It then lies about two spaces above the pleural margin: it crosses the 6th rib in the midclavicular line and the 8th rib in the midaxillary line, and reaches the vertebral column at the level of the 10th rib.

The markings of the lung margin on the left side are similar except for the **cardiac notch**. At the level of the 4th costal cartilage the border of the left lung runs almost horizontally to the left for 2-3cm, then descends to cross the 6th rib in the mid-clavicular line.

Observe the completed pleural and lung markings. Compare them with the ones that you drew in the previous class and with the diagram provided. Locate the **costodiaphragmatic recess** inferiorly.

A number of pathological conditions may lead to accumulation of either blood, pus or lymph within the pleural cavity. Discuss these with a demonstrator.

LUNG FISSURES

On both sides, draw a line from the posterior lung margin just below the spine of T3 to the 6th costal cartilage anteriorly. This marks the position the oblique fissure separating the upper and the lower lobes of the lung.

On the right side, draw a line starting anteriorly at the 4th costal cartilage and running horizontally back to the oblique fissure. This marks the horizontal fissure which separates the upper and middle lobes of the right lung.

Does the pleura extend into the lung fissures?

Again compare these with the diagram.

LUNG SOUNDS

Place a stethoscope over a partner's chest immediately below the clavicle and listen to the sounds of normal and deep breathing. In this position you are listening to the upper lobe. Make sure the ear pieces are pointing forwards in your ears - if you have problems using the stethoscope, ask a demonstrator to help.

What you are hearing are called "normal breath sounds" by clinicians.

Write a brief description of how they sound to you. Note whether your partner claims any respiratory problem e.g. cold, asthma.

Where would you place your stethoscope in order to listen to: the lower lobe?

the middle lobe of the right lung?

Do you think the breath sounds would be altered if the lung alveoli were full of fluid, as in pneumonia?

Or if the bronchi contained excessive mucous, as in bronchitis?

If so, how? Discuss your ideas with a demonstrator.

RADIOLOGY

Examine a standard (postero-anterior) radiograph of a normal chest taken in inspiration and familiarise yourself with some of its major features.

Check the x-ray for breast shadows, which will enable you to identify the sex of the subject, then locate the medial ends of the clavicles. In a correctly positioned x-ray these should lie symmetrically just outside the outline of the vertebral column. You may just be able to identify the outline of the jugular notch between them.

Identify the first rib, which is notably wider than the other ribs. The other ribs can then be located by counting down from the first.

Locate the domes of the diaphragm on either side and note that the central area of the diaphragm is continuous with the heart shadow.

Now study a p-a radiograph taken in expiration.

What differences can you see in; the orientation of the ribs?

the size of the intercostal spaces?

the position of the diaphragm?

the orientation of the heart shadow?

Identify the translucent tracheal shadow which should lie in the midline down to the 4th thoracic vertebra.

Examine the translucent lung fields, noting the apices of the lungs and their medial, costal and diaphragmatic boundaries which should be sharply defined. Note the relationships of the lungs to the bony landmarks of the chest.

Note that the lung fields appear progressively more translucent passing from the hilus (root) to the periphery.

Describe any abnormalities you can see in the radiographs and from your knowledge of the mechanisms of respiration, explain how they might have occurred.

What is responsible for the relative radio-opacity of the hilus and the shadows which radiate from it?

How does the appearance of the lungs differ between radiographs taken in inspiration and expiration?

One of the radiographs shows a patient with pneumothorax.

What does this term mean?

How might it have occurred?

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

