Session 5:

The Respiratory System

The respiratory system is the network of organs and tissues that help you breathe. It includes your airways, lungs, and blood vessels.

DOCTORS LIVE

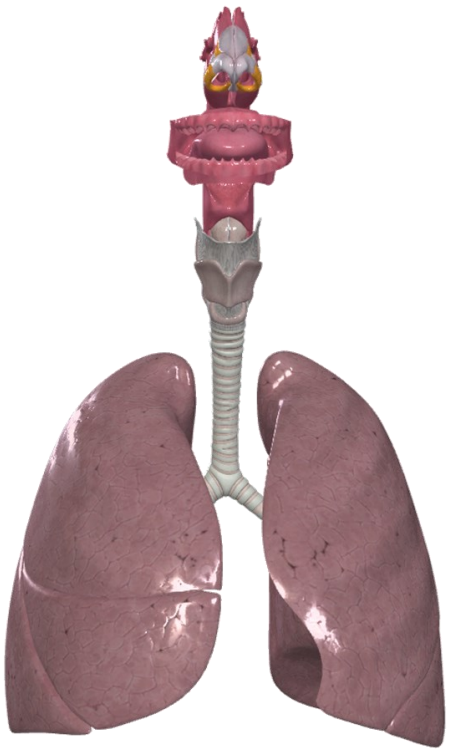
What is the respiratory system?

⇒ Primary organs are the lungs which is where gas exchange takes place. It is closely related to the cardiovascular system.

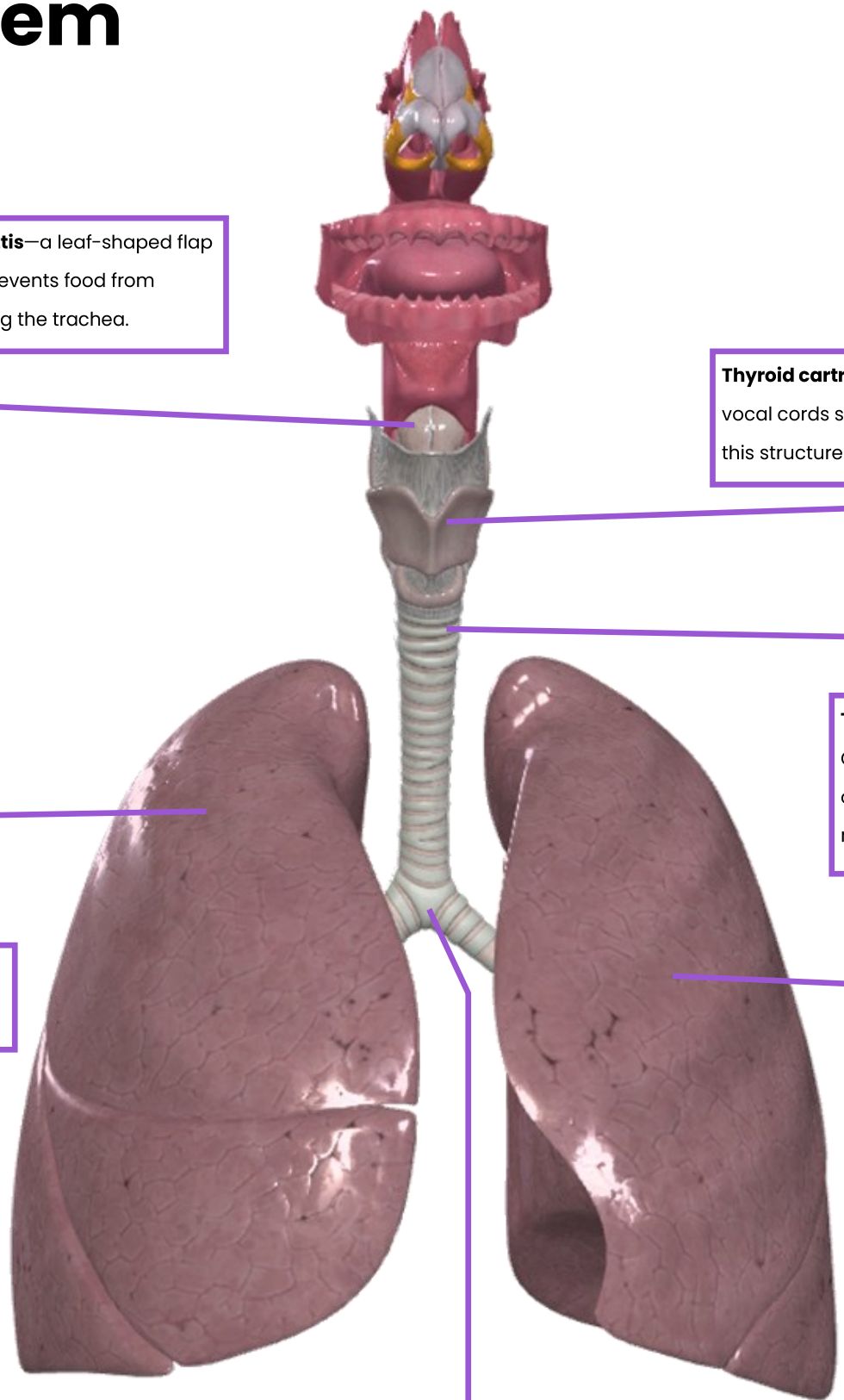
⇒ Includes the nose and mouth, pharynx, larynx, trachea, bronchi, bronchioles, alveoli.

⇒ Functions:

- ◊ Oxygen in
- ◊ CO2 out
- ◊ Phonation (producing sound)
- ◊ Maintain acid-base balance – pH homeostasis
- ◊ Humidifies and warms air



Structures of the respiratory system



Epiglottis—a leaf-shaped flap that prevents food from entering the trachea.

Thyroid cartridge—the vocal cords sit behind this structure.

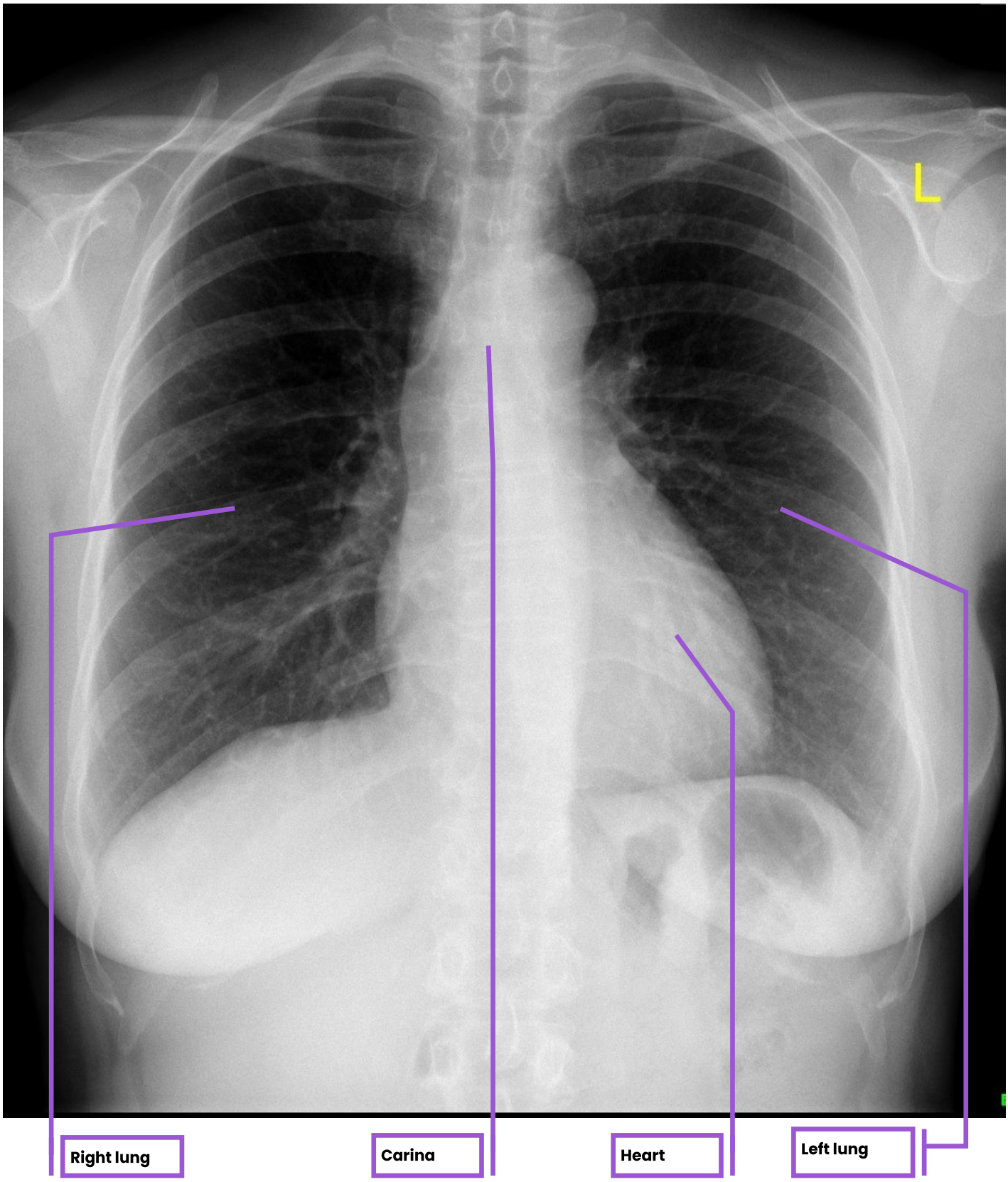
Trachea with C shaped cartilage rings.

Right lung has 3 lobes.

Left lung has 2 lobes.

Carina (where the trachea bifurcates i.e. divides into 2).

Chest X-ray:



An example of a Chest X-ray. This type of image is one of the most commonly requested investigations in the emergency department. It allows a quick assessment of the appearance of the lungs of the patient. The lungs contain air and therefore look dark on an X-ray. Conversely dense structures like bone appear white. Both lungs should look symmetrical and should both be the same level of darkness. Notice how the heart sits more towards the left hand side.

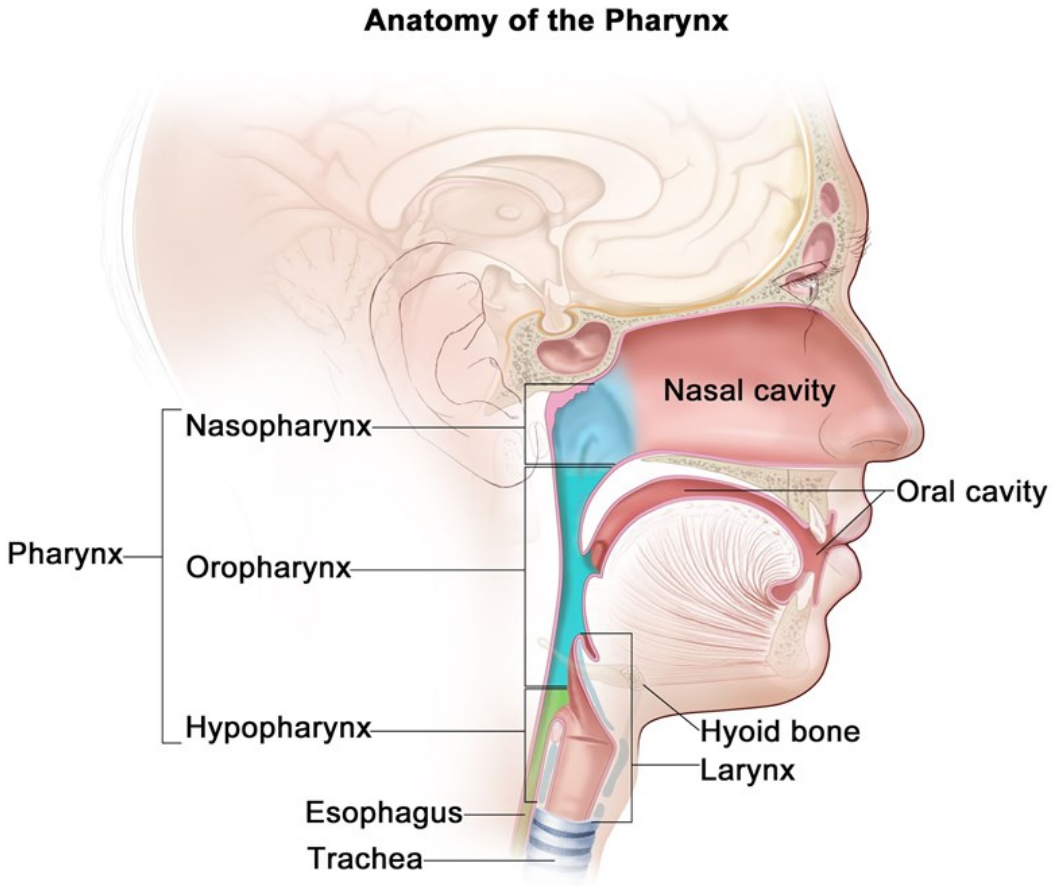
What is the pharynx?

⇒ A hollow tube that starts behind the nose and extends down the neck to the oesophagus and larynx.

⇒ Three parts:

- ⇒ nasopharynx
- ⇒ oropharynx
- ⇒ hypopharynx

⇒ Carries food to the oesophagus and air to the larynx (the voice box)

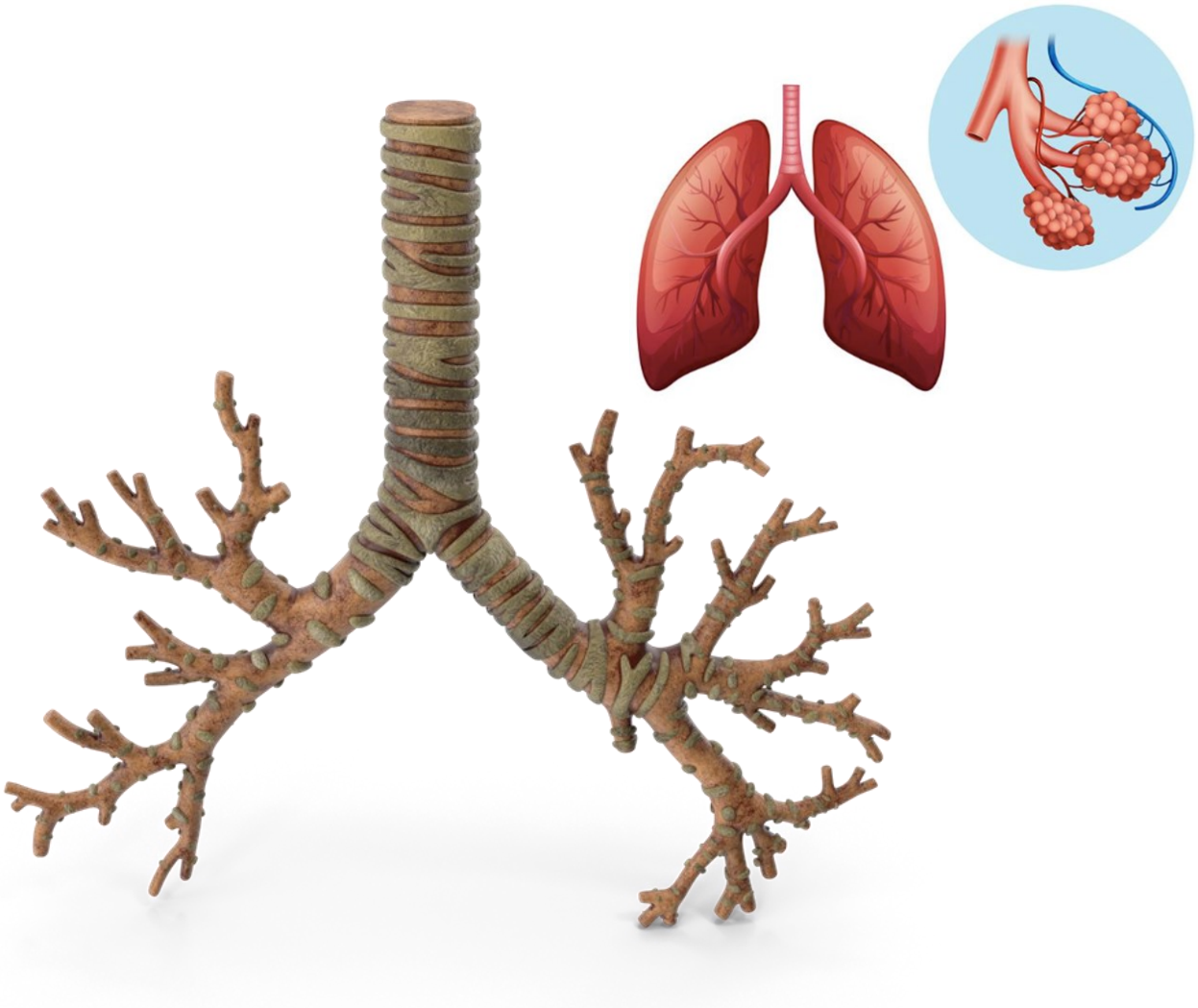


What are the airways?

Trachea (windpipe) bifurcates (divides into 2) into right and left main bronchus at the **carina**. The right main bronchus is more vertical than the left main bronchus, hence if food is accidentally inhaled it is more likely to end up in the right main bronchus. The main bronchus then continues to divide into:

- ⇒ Lobar bronchi
- ⇒ Primary bronchioles
- ⇒ Terminal bronchioles

There are approximately 20 divisions until the terminal bronchioles which become alveoli. This is to ensure there is a large surface area for gas exchange.

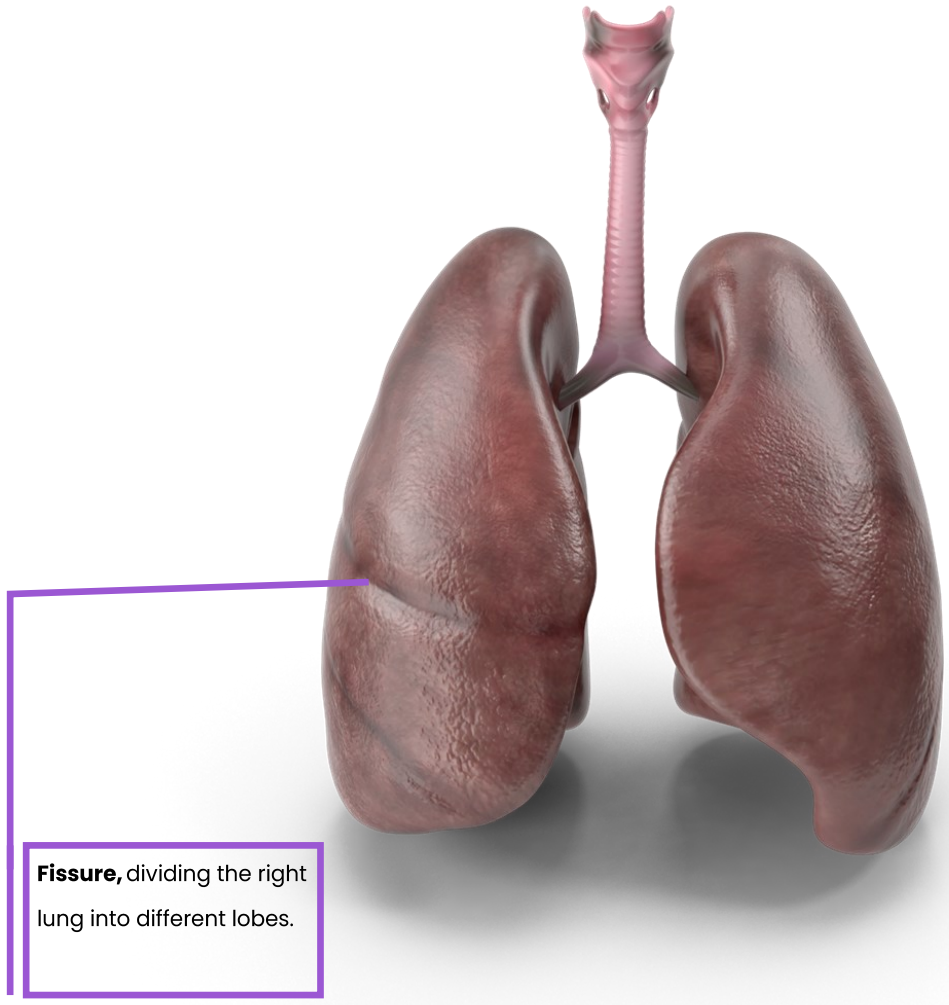


What are the lungs?

The lungs are a pair of spongy, air-filled organs located on either side of the chest (thorax). The trachea conducts air into the lungs through its tubular branches which eventually become terminal bronchioles. They then end in clusters of microscopic air sacs called alveoli.

In the alveoli, oxygen from the air is absorbed into the blood. Carbon dioxide (a waste product of metabolism) travels from the blood to the alveoli, where it can be breathed out.

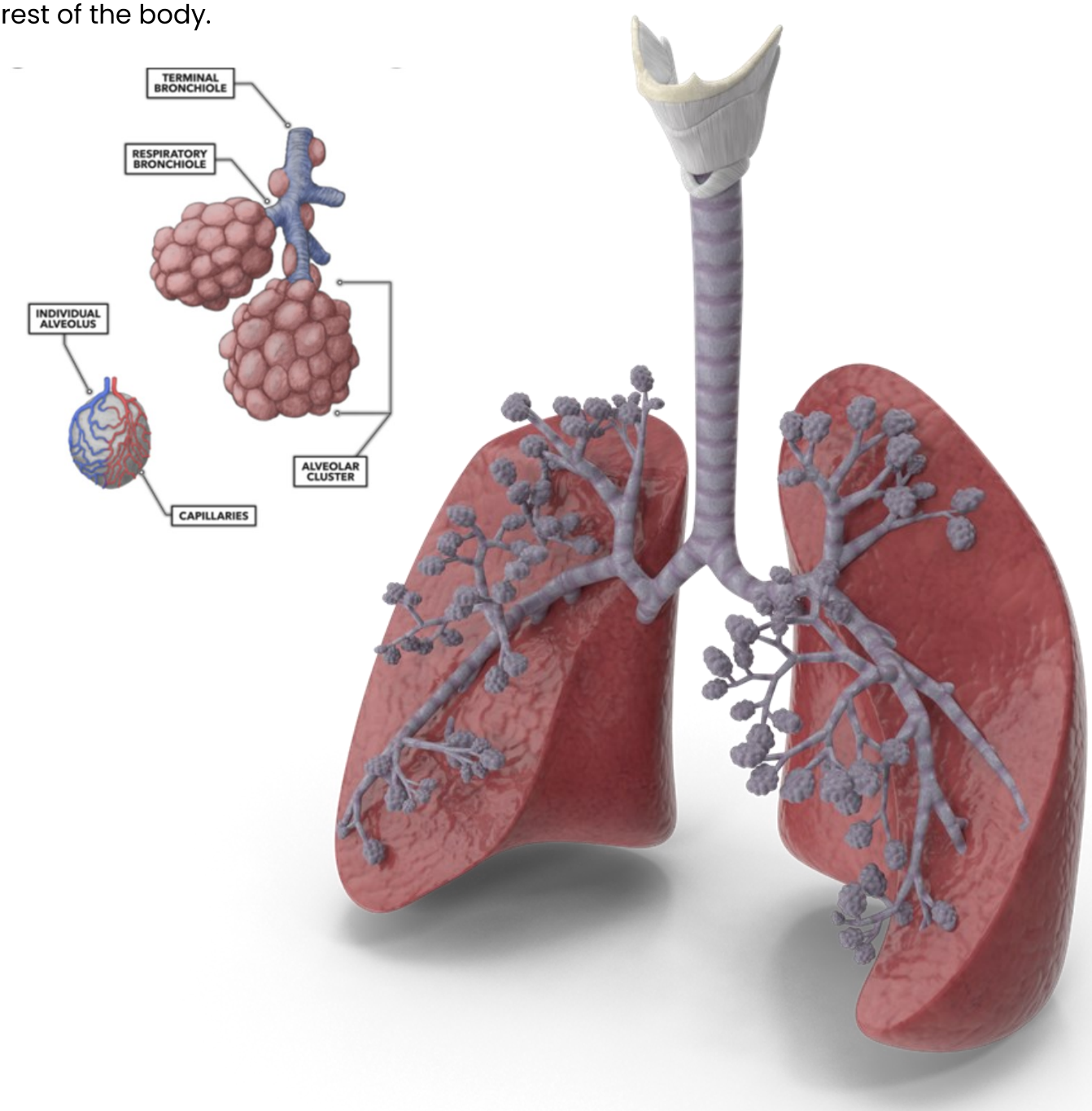
The lungs are split into functional units known as lobes. The **right lung** is divided into **3** lobes (upper, middle and lower) whereas the **left lung** is divided into only **2** lobes (upper and lower). The division between the lobes are called **fissures**.



What are the alveoli?

Alveoli are tiny air sacs in the lungs where gas exchange takes place. On average a human has around 480 million alveoli. The reason why we have so many is to increase surface area to maximize gas exchange.

Each alveoli is covered by tiny blood vessels called capillaries. The blood supply takes the oxygen from the alveoli and gives off carbon dioxide to the alveoli. The oxygenated blood is then taken to the left side of the heart, where it is pumped to the rest of the body.



What are the muscles of breathing?

Muscles of breathing are those that contribute to inhalation and exhalation by aiding in the expansion and contraction of the thoracic cavity.

The main muscle of breathing is called the diaphragm. This is a dome shaped muscle at the bottom of the thorax that drives quiet breathing.

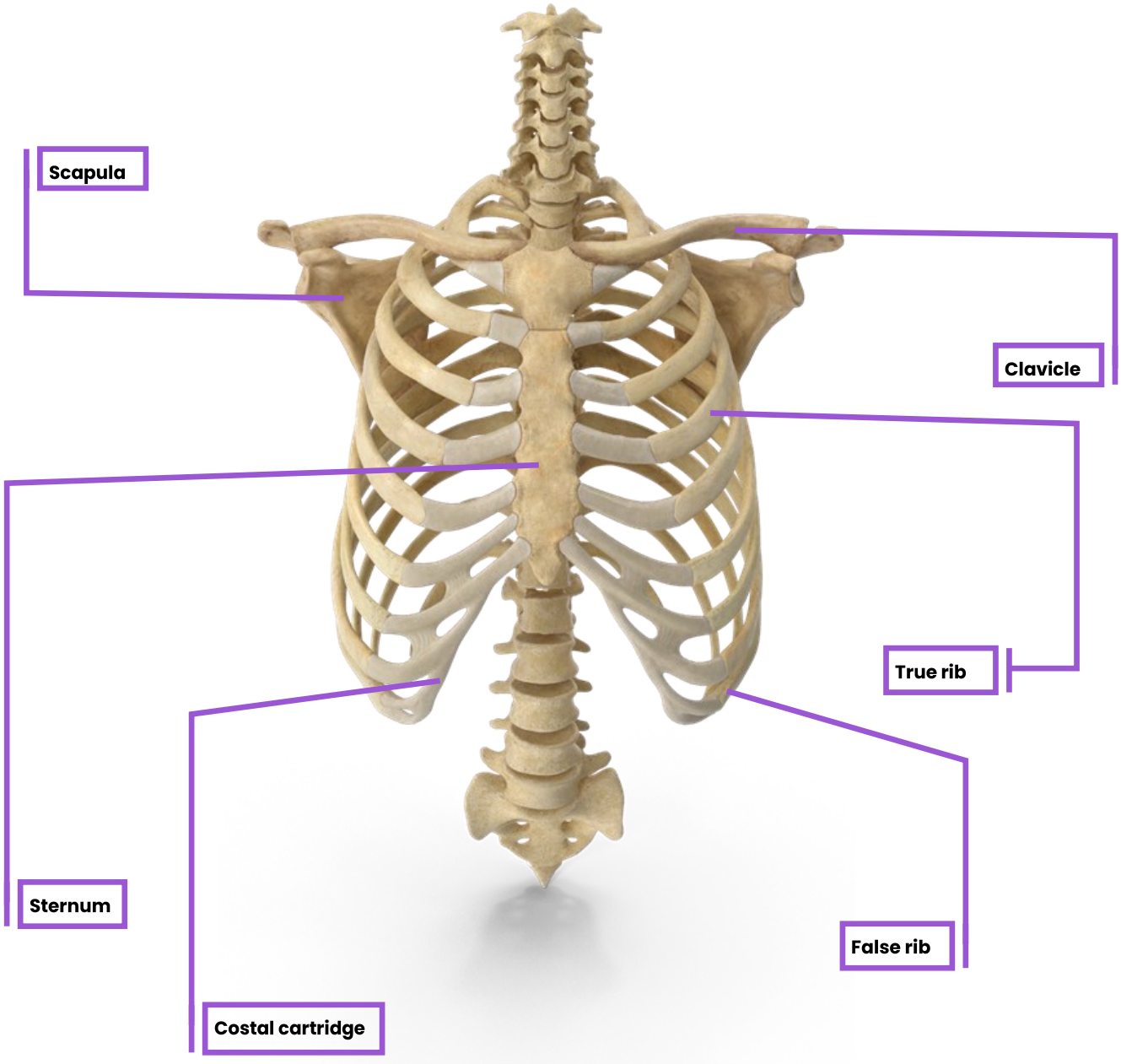
In respiratory distress or during excercise– all local muscles contribute to effort including muscles in the neck, shoulder, abdomen.

The **diaphragm** is the major muscle of breathing. It is a large, dome-shaped muscle that contracts rhythmically and continually, and most of the time, involuntarily. It is found below the lungs. When breathing in, the diaphragm contracts and flattens and the chest cavity enlarges. This contraction creates a vacuum, which pulls air into the lungs. When breathing out, the diaphragm relaxes and returns to its domelike shape, and air is forced out of the lungs.

What protects the respiratory system?

The respiratory system is protected by the rib cage. This is made 12 pairs of ribs with their costal cartilages, the sternum (at the front) and the thoracic vertebrae at the back.

The ribs are classified into true and false ribs. The true ribs are the first seven. They are connected directedly to the sternum with the costal cartilages.

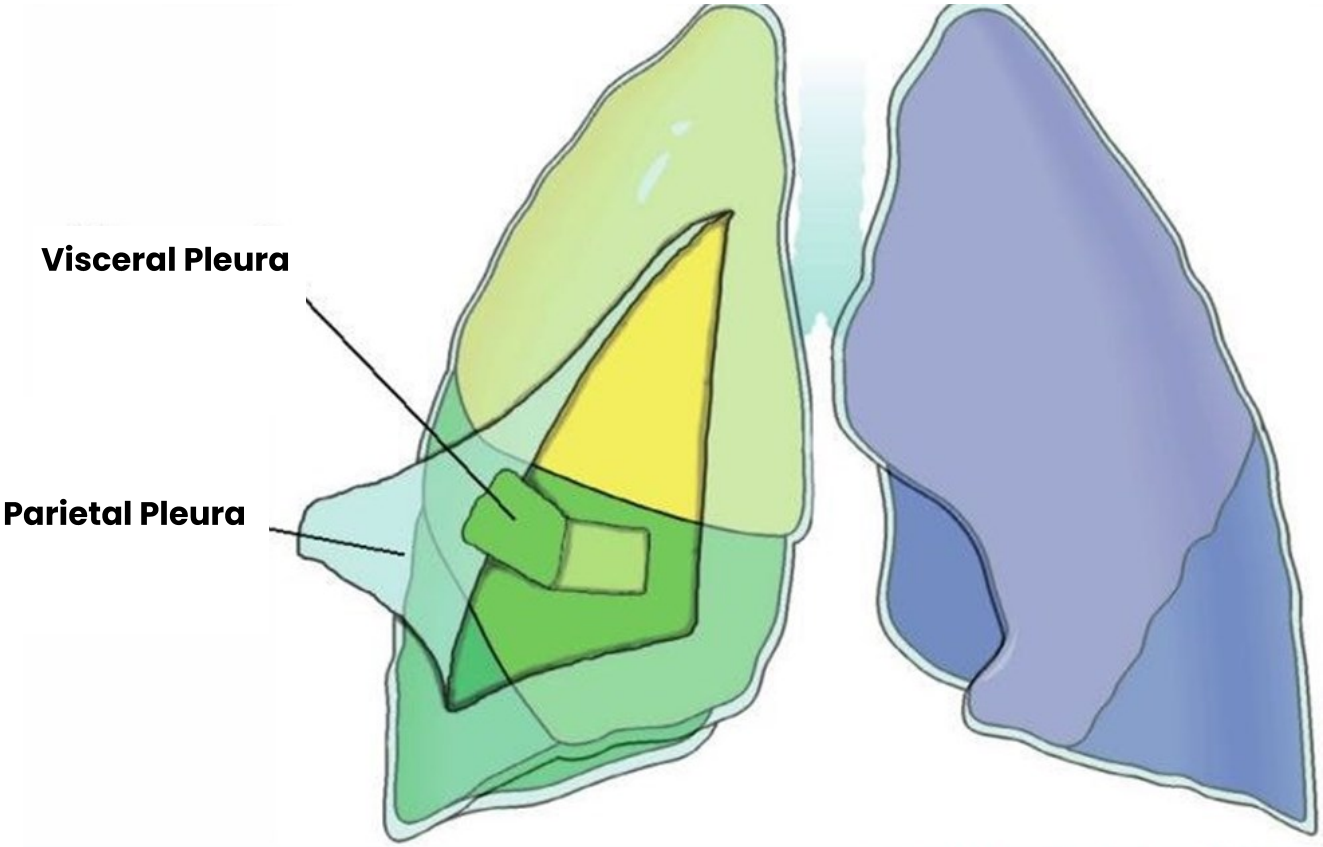


What is the pleura?

⇒ The pleura consists of a two-layered membrane that covers each lung.

⇒ It's role is to protect and cushion the lungs and reduce any friction between the lungs, rib cage, and chest cavity.

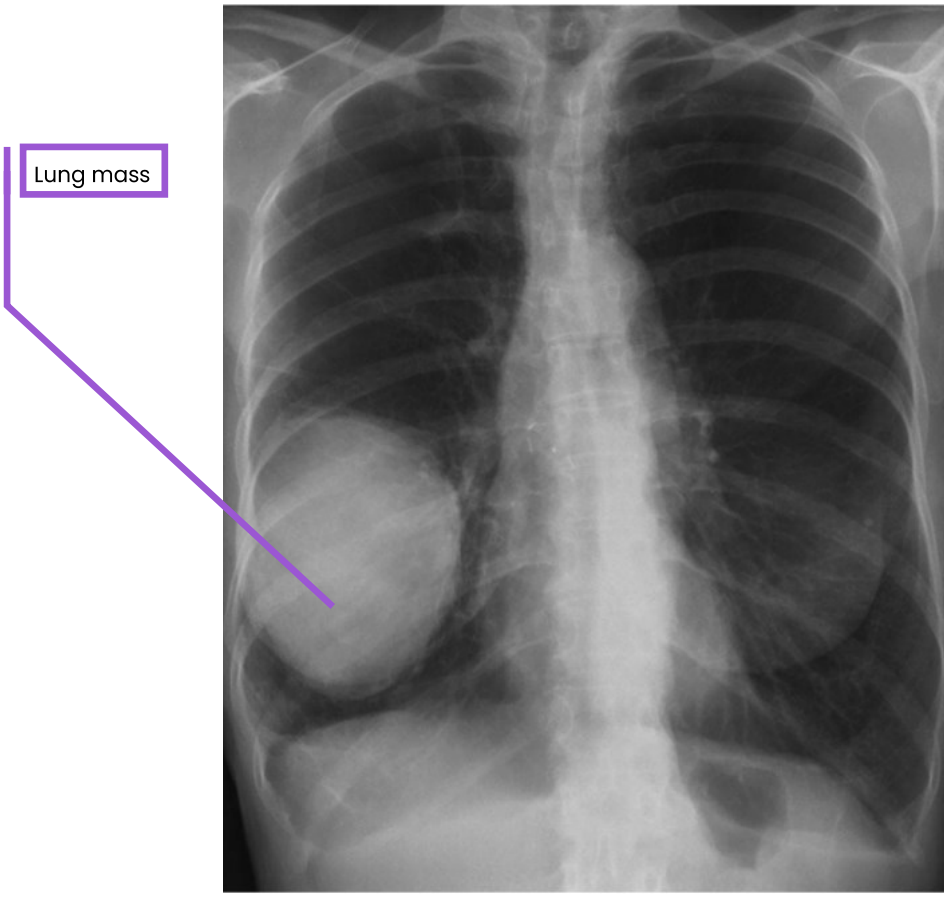
⇒ The 2 layers are the visceral pleura (which is attached to the lungs) and the parietal pleura (which is attached to the thoracic cage).



Let's have a look at a case

65 year old man comes into your clinic with a persistent cough (for months) and weight loss. The cough is red stained. He is also describing generally not feeling very well. He otherwise has not seen his GP for the last 30 years. He smokes 20 cigarettes a day for the last 30 years.

This patient has several red flag symptoms—that warrant further investigation. He is coughing up a red substance (this could be blood), the cough is persistent and he is experiencing weight loss. He is also a smoker. This is a big risk factor for cancer.



A Chest X-ray was carried out for the patient to assess the lungs. In this X-ray you can see a white density in the right lung. This is very suspicious for a lung mass. This mass is likely to be a tumour or cancer. This patient will need to be referred to a multi-disciplinary team (MDT) meeting. This is a meeting where specialist doctors and healthcare professionals come to together to discuss how to treat complicated patients. Usually this meeting includes a respiratory consultant (lung specialist doctor), an oncologist (cancer specialist doctor), a radiologist (imaging specialist doctor) and a cardiothoracic surgeon (a surgeon specialising in lungs and heart conditions). They will discuss how to best treat this patient for example if the mass is suitable for surgery or for chemotherapy. This will depend on a lot of factors such as the patient's health, if the cancer has already spread and the type of cancer.

Session 5 – Respiratory Learning Points

The respiratory system is the network of organs and tissues that help you breathe.

Anatomy

The nose and mouth lead into the airways which lead into the alveoli which are part of the lung tissue. The lungs are surround by a protective layer called the pleura.

Physiology

Breathing is coordinated and requires the muscles of respiration (the main one being the diaphragm). Gas exchange occurs in tiny sacs called alveoli.

Pathology

Diseases of the respiratory system can be dangerous as gas exchange is vital for survival. Lung diseases are commonly investigated with X-rays and CT scans.