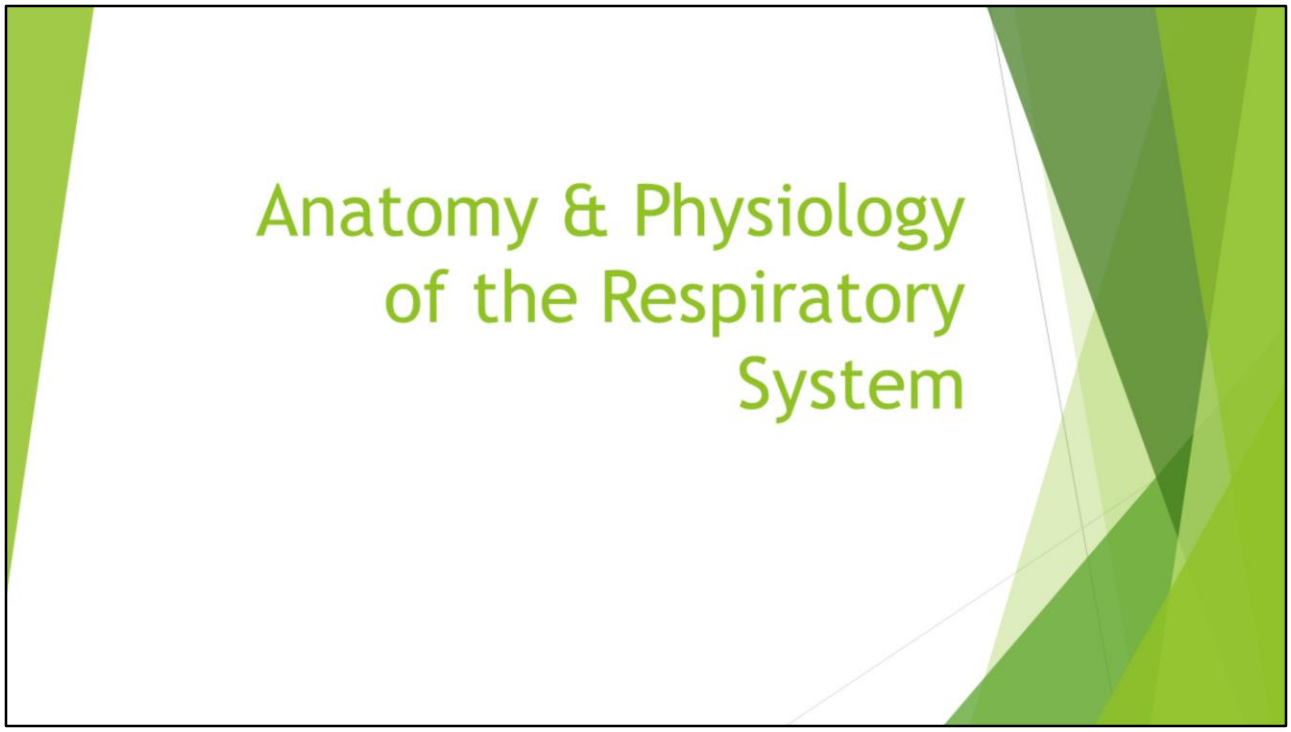
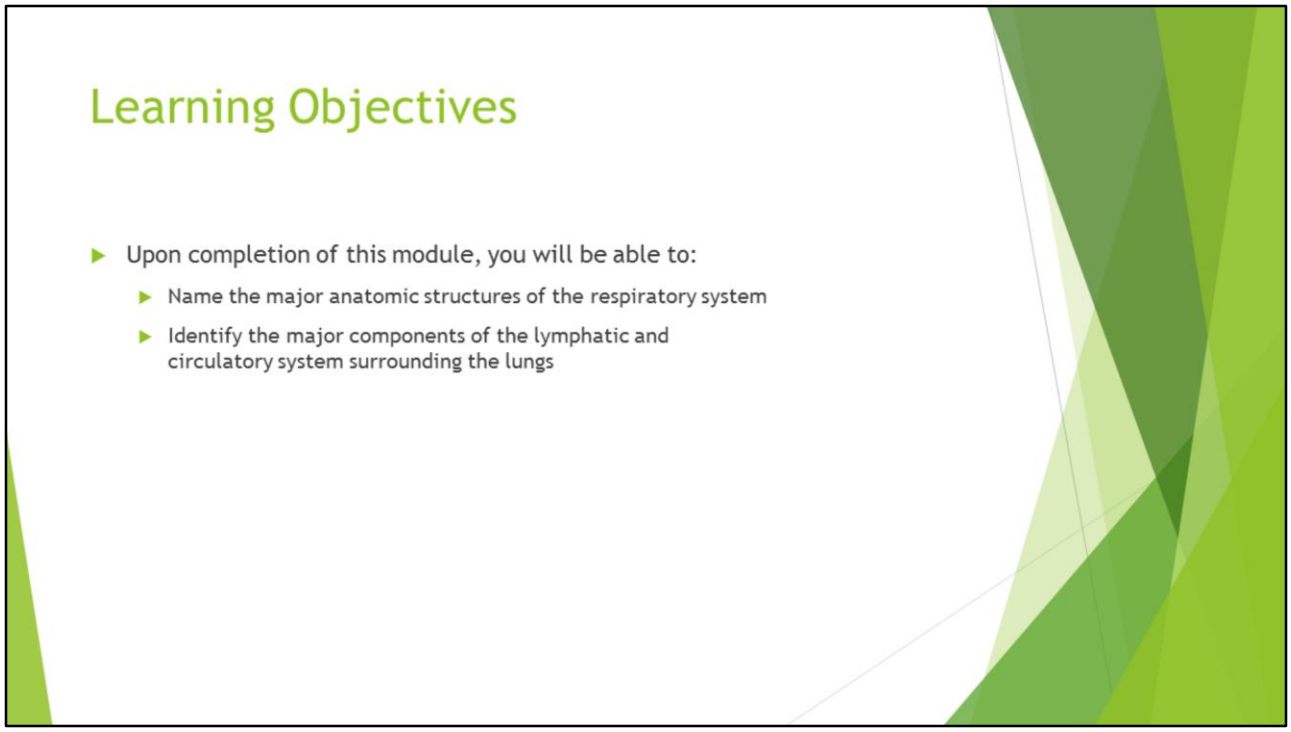


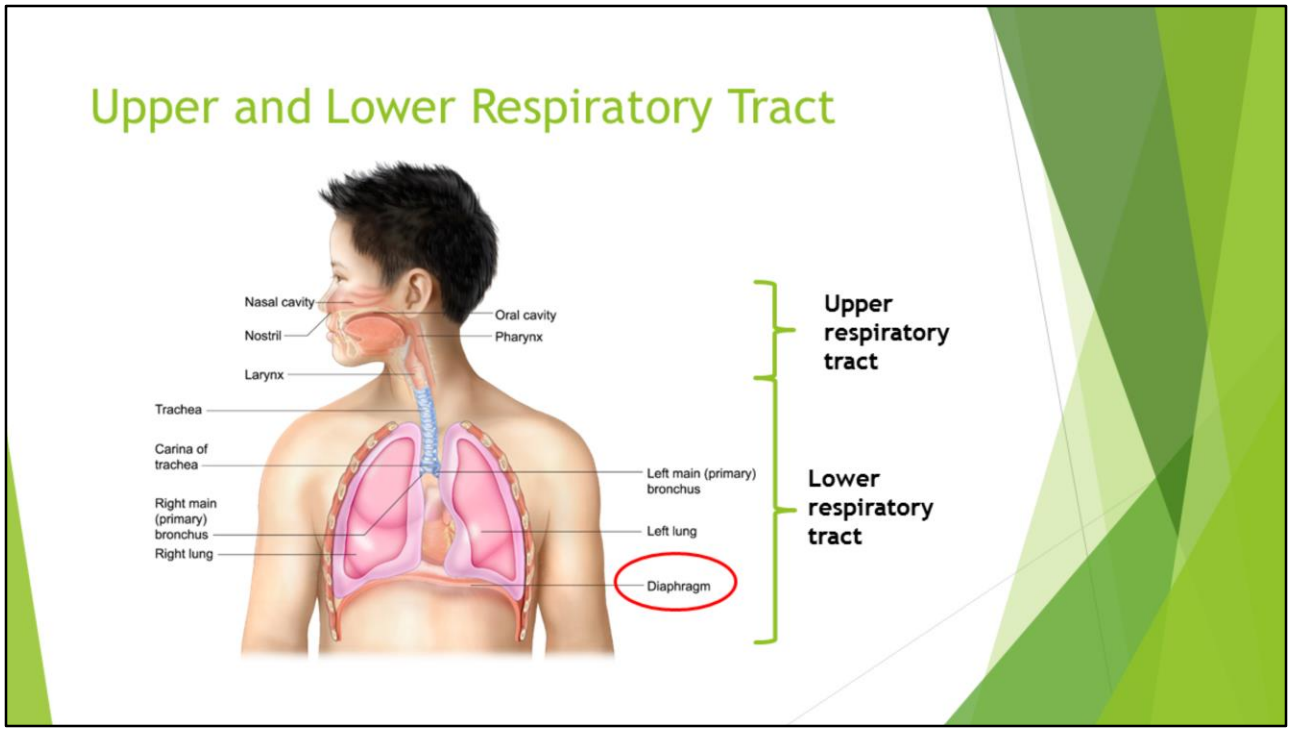
Let's turn to *Module 1: Anatomy and Physiology*

In this module, we will provide a top-line overview of the anatomy related to the respiratory system.



Upon completion of this module, you will be able to:

Name the major anatomic structures of the respiratory system, and identify the major components of the lymphatic and circulatory system surrounding the lungs.



Let's review what we know about the respiratory system as a whole. It's divided into the upper and lower respiratory tracts.

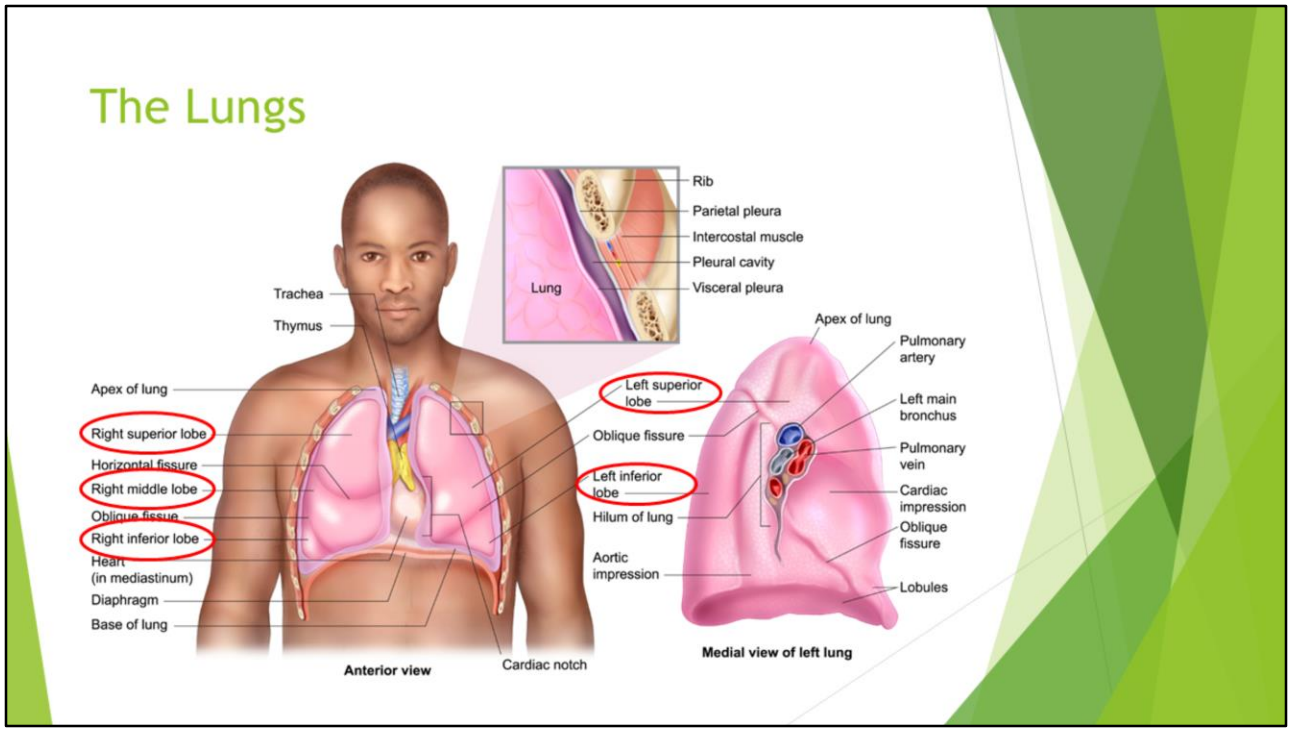
The upper respiratory system consists of all the structures from the nose to the larynx.

The lower respiratory system includes all of the structures below the larynx, including the trachea, bronchi, and lungs.

Sometimes, the respiratory muscles, such as the diaphragm, are also included as part of the lower respiratory system.

REFERENCE

Marieb EN, Hoehn K. *Human Anatomy and Physiology*. Boston. Pearson Inc. 2015.



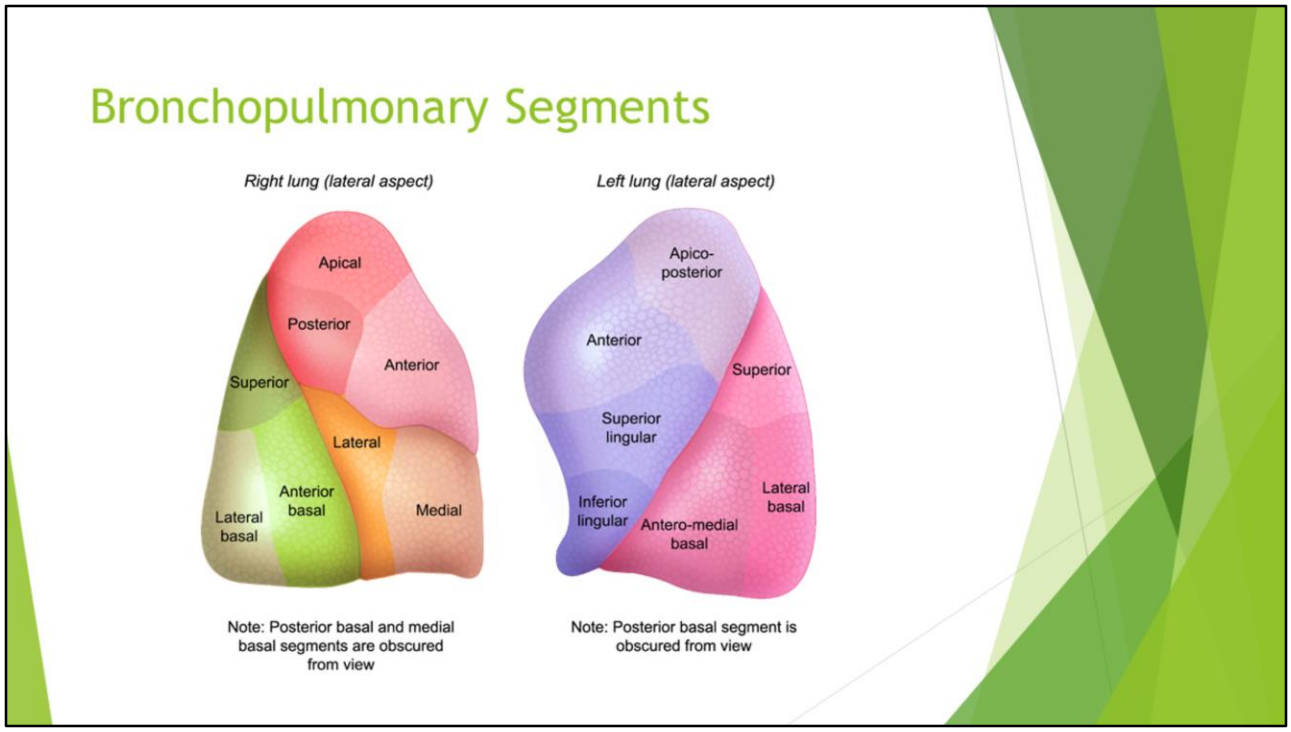
Let's review the anatomic structures of the respiratory system, starting with the lungs. The lungs are 2 sponge-like organs located in the chest. They are surrounded by the rib cage.

Each lung consists of lobes—3 on the right, including the superior, middle, and inferior, and 2 on the left, including the superior and inferior lobes.

Note that the left lung is slightly smaller because the heart takes up some room on that side of the chest.

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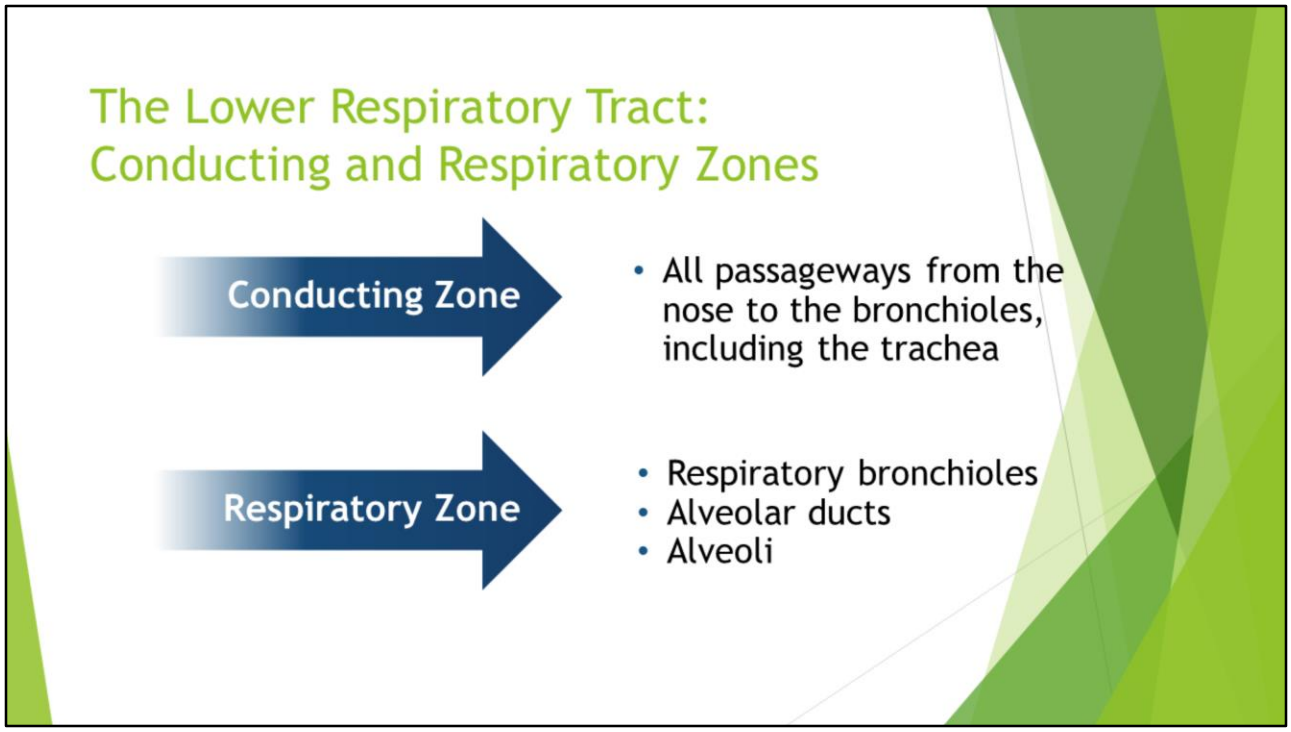
Betts JG, Desaix P, Johnson E. *Anatomy and Physiology.* OpenStax College. Rice University. 2013 Edition.



A bronchopulmonary segment is a division of the lobe; each lobe houses multiple bronchopulmonary segments. Each of these segments receives its own tertiary bronchus and is supplied by blood from its own artery.[1]

REFERENCES

1. Betts JG, Desaix P, Johnson E. *Anatomy and Physiology.* OpenStax College. Rice University. 2013 Edition.



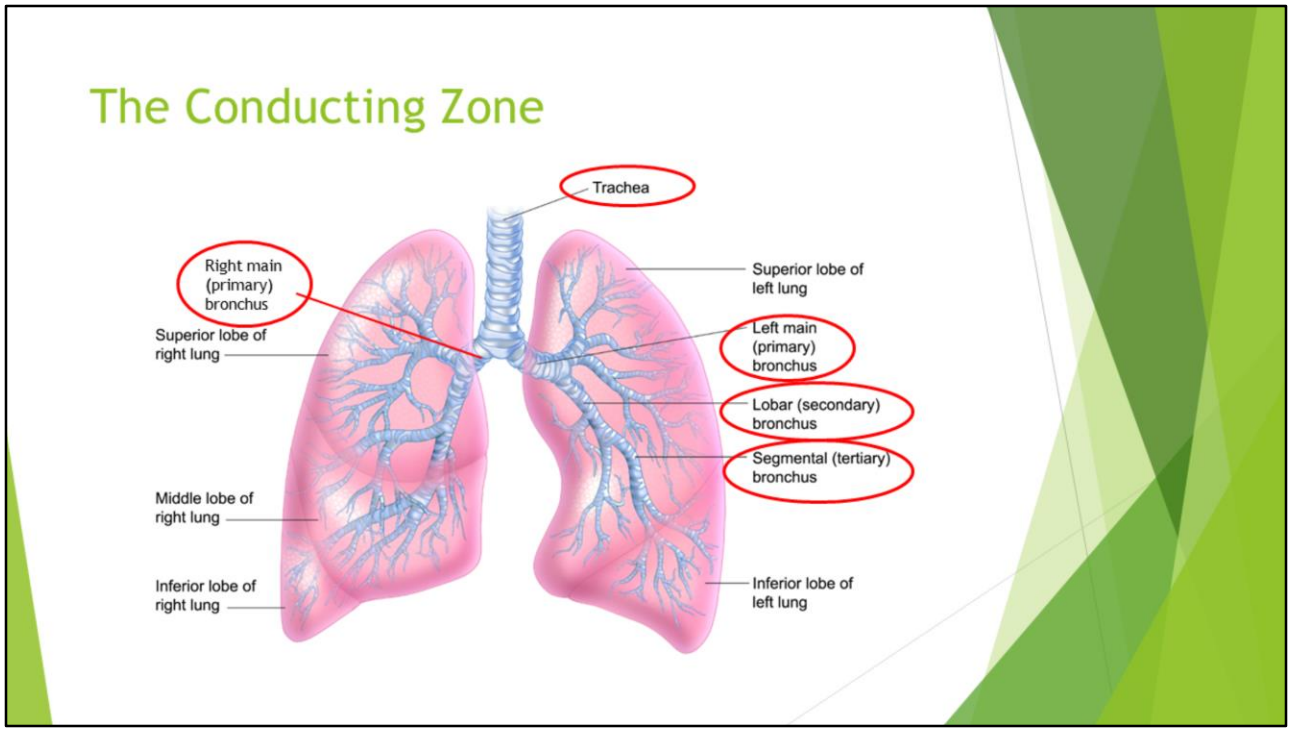
The lower respiratory tract is divided into 2 sets of structures: a conducting zone, which simply provides for the passage of air, and the respiratory zone, where gas exchange actually occurs.

The conducting zone of the lower respiratory system consists of all passageways from the nose to the bronchioles including the trachea.

The respiratory zone consists of the respiratory bronchioles, alveolar ducts, and alveoli. All of these structures are microscopic.

REFERENCE

Marieb EN, Hoehn K. *Human Anatomy and Physiology*. Boston. Pearson Inc. 2015.



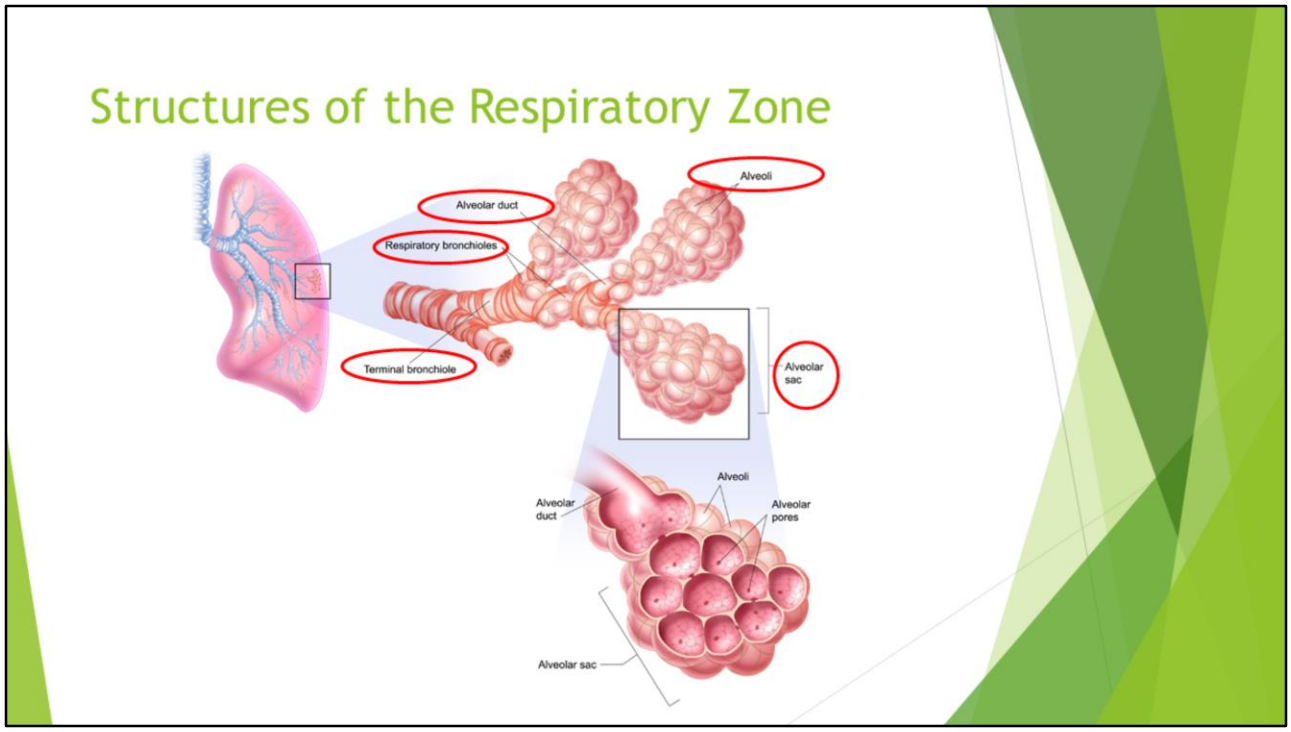
The trachea—also known as the "windpipe"—is part of the air-conducting zone of the lower respiratory system. It descends from the larynx through the neck and into the **mediastinum**.[8] It ends by dividing into 2 bronchi at approximately mid-chest level. In humans, it is about 4 inches (10-12 cm) in length, about 3/4 inches (1.9 cm) in diameter, and is very flexible.[8] The trachea is surrounded and supported by rings made of cartilage that prevent it from collapsing and keep it open despite pressure changes occurring during normal breathing.

The bronchi are air passages that extend from the trachea, which divides to form the right and left primary bronchi.[8] The bronchi branch repeatedly, forming a structure sometimes referred to as the bronchial tree, because it resembles an inverted tree.[8] Each bronchus enters the lung through the medial depression of the lung known as the hilum.[8]

Once the bronchi enter the lungs, they first divide into the lobar, or secondary, bronchi. There are 3 lobar bronchi in the right lung, and 2 in the left lung, each supplying 1 lung lobe. The lobar bronchi, in turn, branch again into the segmental, or tertiary bronchi, which divide repeatedly into smaller and smaller bronchi. Passages smaller than 1 mm in diameter are known as bronchioles; the smallest of these are called terminal bronchioles, which are less than 0.5 mm in diameter.[8]

REFERENCE

Marieb EN, Hoehn K. *Human Anatomy and Physiology*. Boston. Pearson Inc. 2015.

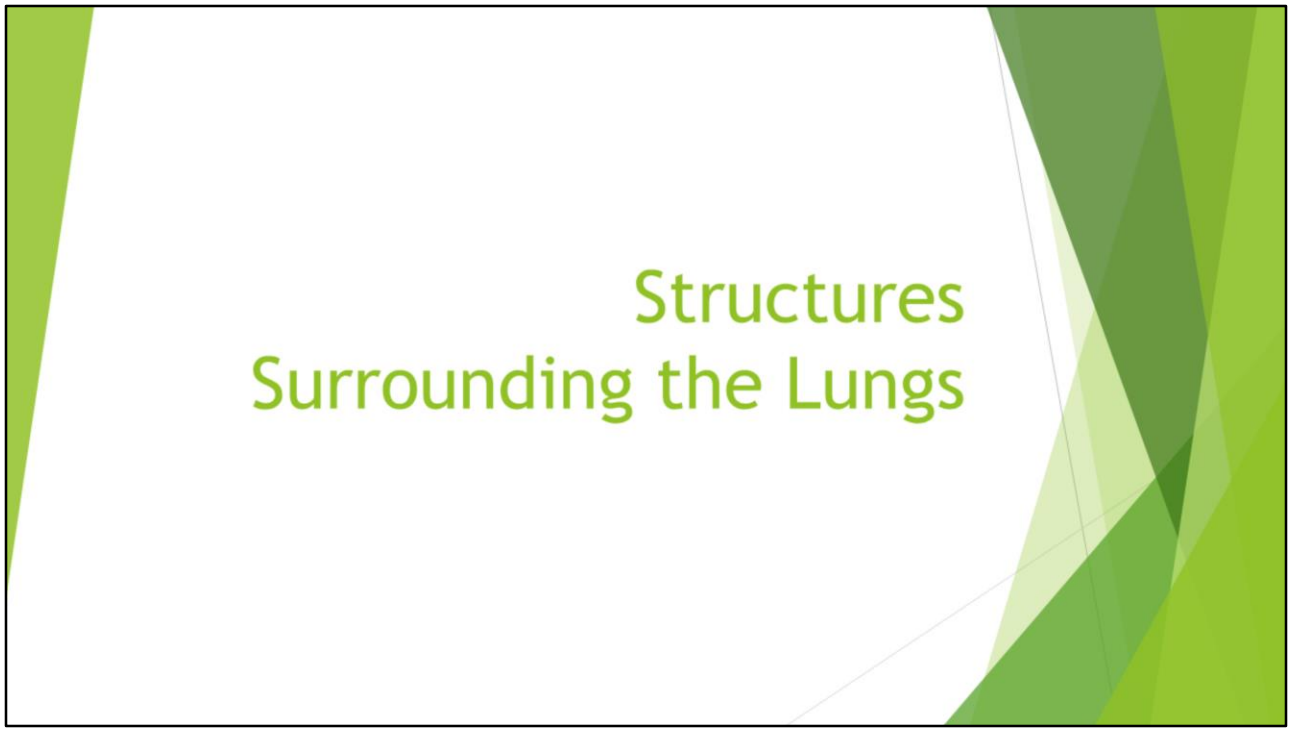


The respiratory zone, which is defined by the presence of thin-walled air sacs called alveoli, begins where the terminal bronchioles feed into respiratory bronchioles within the lung.

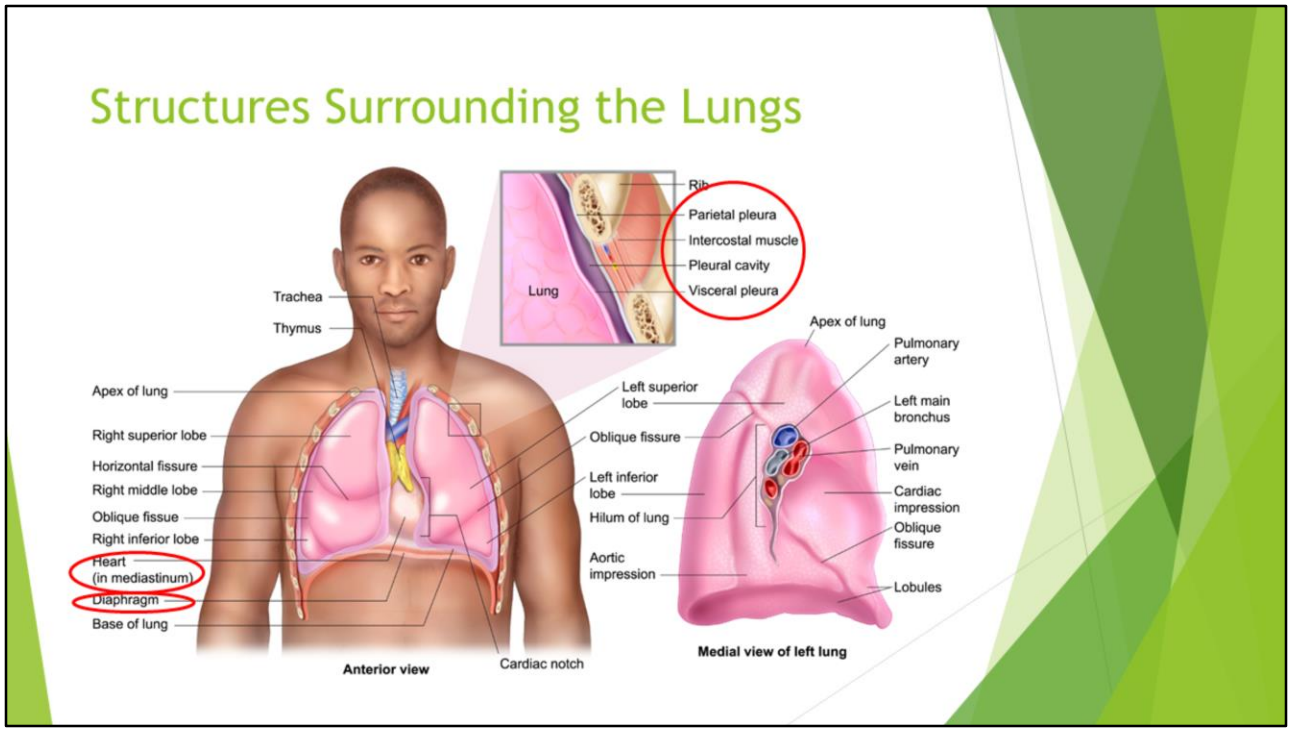
The terminal bronchioles lead to the alveolar ducts, which consist of rings of smooth muscle, connective tissues, and outpocketing alveoli. The alveolar ducts terminate in clusters of alveoli known as alveolar sacs. Gas exchange occurs in the alveoli.[8]

REFERENCE

Marieb EN, Hoehn K. *Human Anatomy and Physiology*. Boston. Pearson Inc. 2015.



Now, let's turn to several of the structures that immediately surround the lungs.



The diaphragm is a muscle underlying the lungs that contracts and relaxes. When it contracts, it moves downward and flattens out. As a result, the dimension of the thoracic cavity increases, causing the lungs to expand.[8] The diaphragm works together with the intercostal muscles, which lift the rib cage.[1]

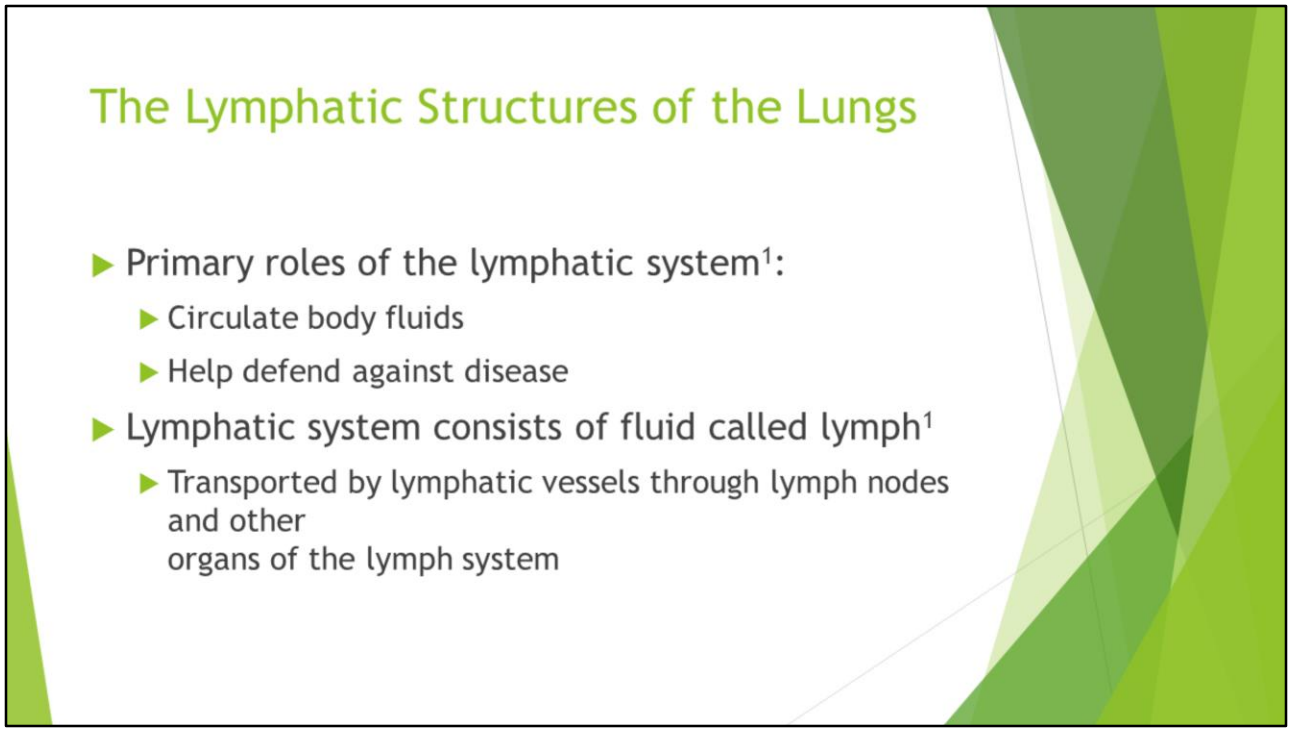
The pleurae are thin, double-layered tissues; the layer called the parietal pleura covers the wall of the thorax and the face of the diaphragm facing the lungs. It continues around the heart and between the lungs. From there, it extends as the layer called the visceral pleura to cover the external lung surface.[1] The pleurae produce pleural fluid, which fills the pleural cavity and provides lubrication, allowing the lungs to glide over the wall of the thorax during breathing.[1]

The heart is located between the lungs, inside the mediastinum. The heart is surrounded by a sac known as the pericardium; major vessels of the heart include the aorta, the *vena cavae*, and pulmonary arteries.[2]

The spine, and its components, the vertebrae, are in close proximity to the lungs.

REFERENCES

1. Marieb EN, Hoehn K. *Human Anatomy and Physiology*. Boston. Pearson Inc. 2015.
2. Betts JG, Desaix P, Johnson E. *Anatomy and Physiology.* OpenStax College. Rice University. 2013 Edition.

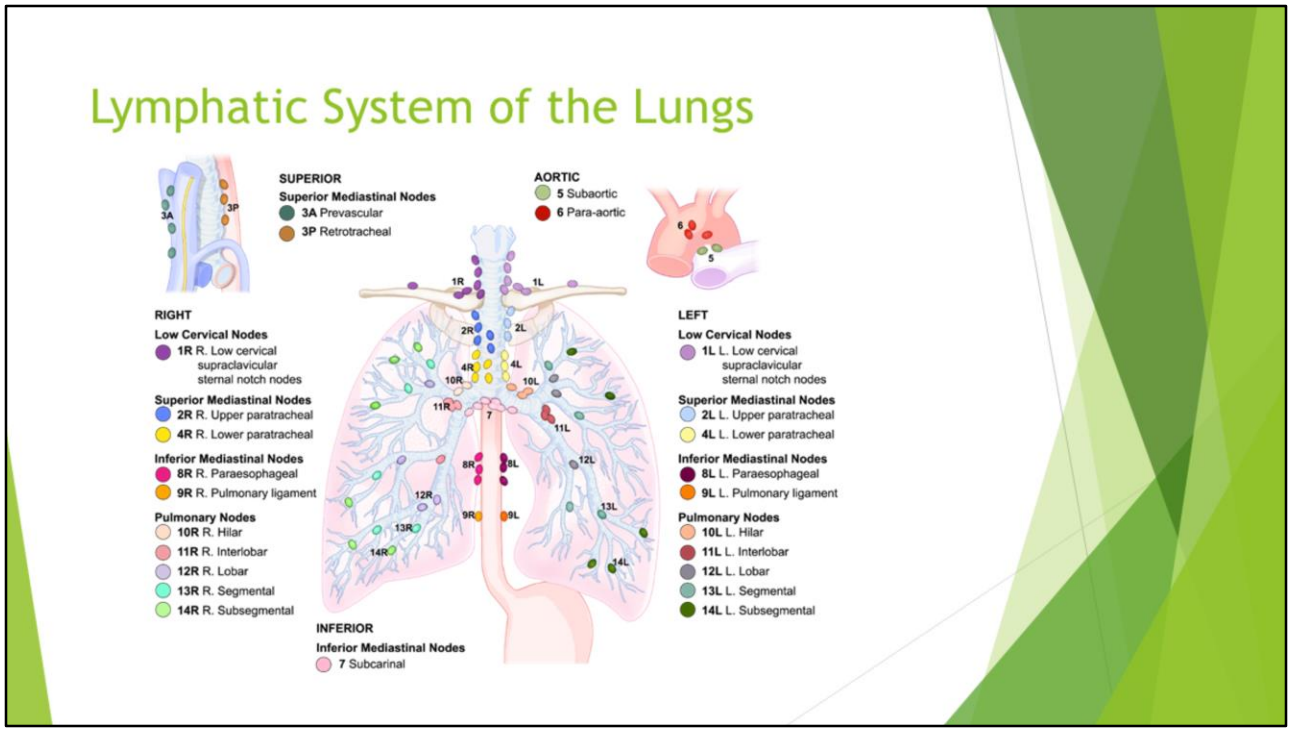


Understanding the lymphatic structures surrounding the lungs is important because lung cancer metastasizes–spreads to other tissues–through the lymph and blood.

The primary role of the lymphatic system is to circulate body fluids and to help defend against disease. The lymphatic system consists of fluid called lymph, which is transported by lymphatic vessels through lymph nodes and other organs of the lymph system.

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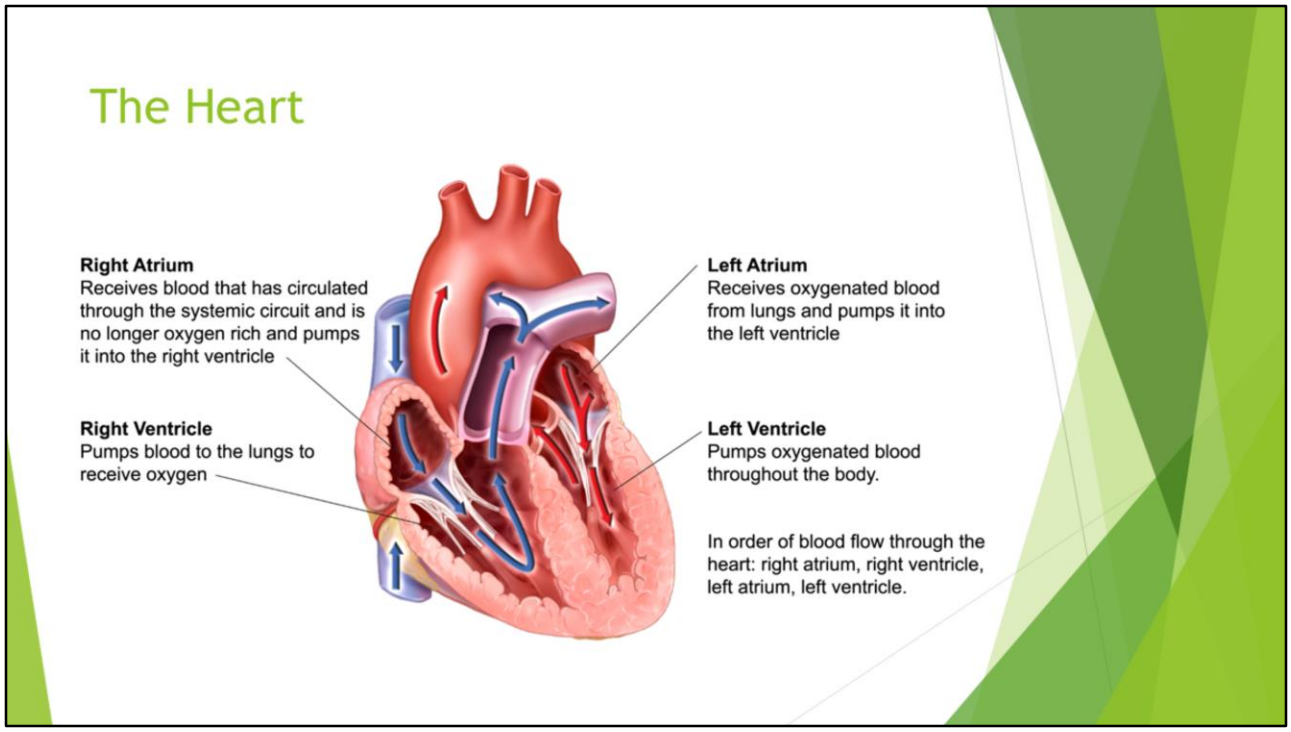
Betts JG, Desaix P, Johnson E. *Anatomy and Physiology.* OpenStax College. Rice University. 2013 Edition.



This figure shows the lymphatic system of the lungs.[1]

REFERENCES

1. El-Sherief AH, Lau CT, Wu CC, Drake RL, Abbott GF, Rice TW. International association for the study of lung cancer (IASLC) lymph node map: radiologic review with CT illustration. *Radiographics.* 2014;34:1680-1691



Lung cancer can invade the circulatory system and utilize it to spread to distant sites. Further, because of the proximity of the heart to the lungs, lung cancer may directly invade the heart and great vessels.[1]

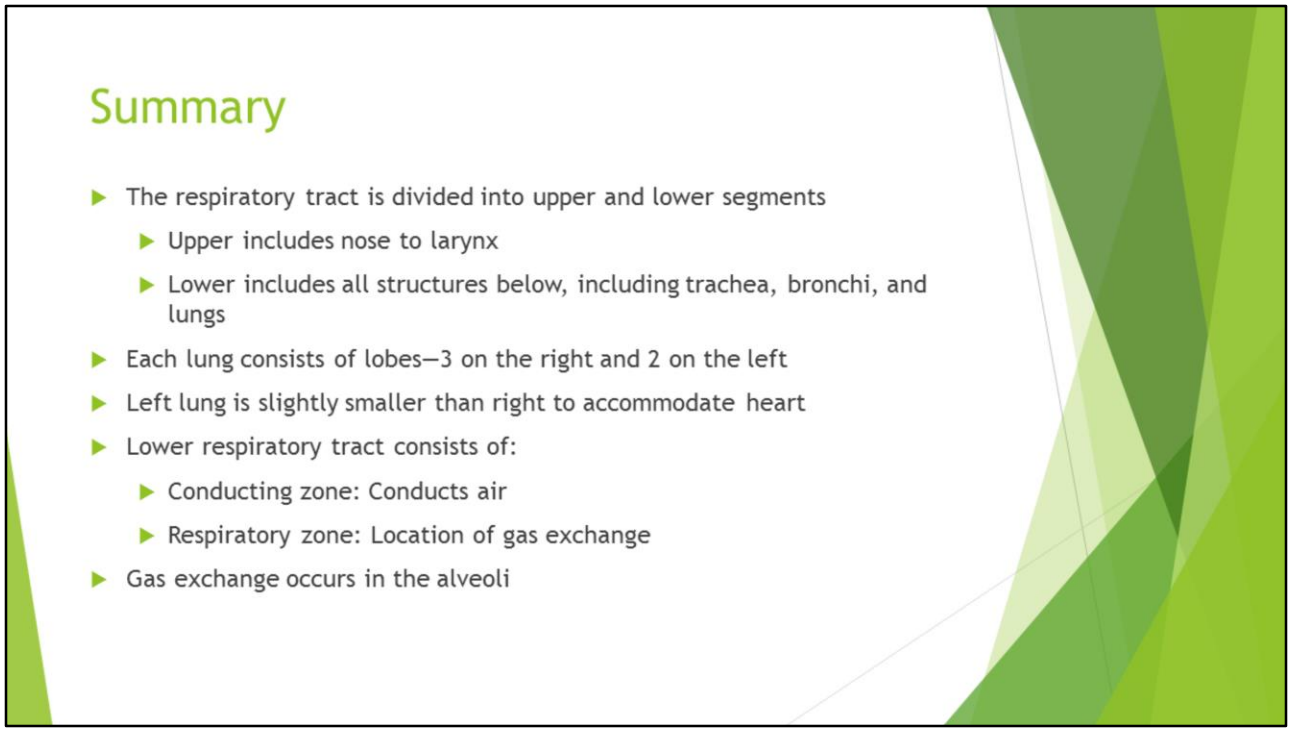
The heart is a 4-chambered, hollow, muscular organ located slightly to the left of the middle of the chest, between the lungs. Each of the 4 chambers of the heart contracts and relaxes regularly to pump blood continuously through the arteries and veins.[2]

The two upper chambers of the heart are the right and left **atria**. These small chambers collect blood from the veins of the pulmonary and systemic circuits of the cardiovascular system.[3]

The 2 lower chambers of the heart are the right and left **ventricles**. These chambers are muscular structures that pump blood into the arteries of the pulmonary and systemic circulation with each contraction.[3]

REFERENCES

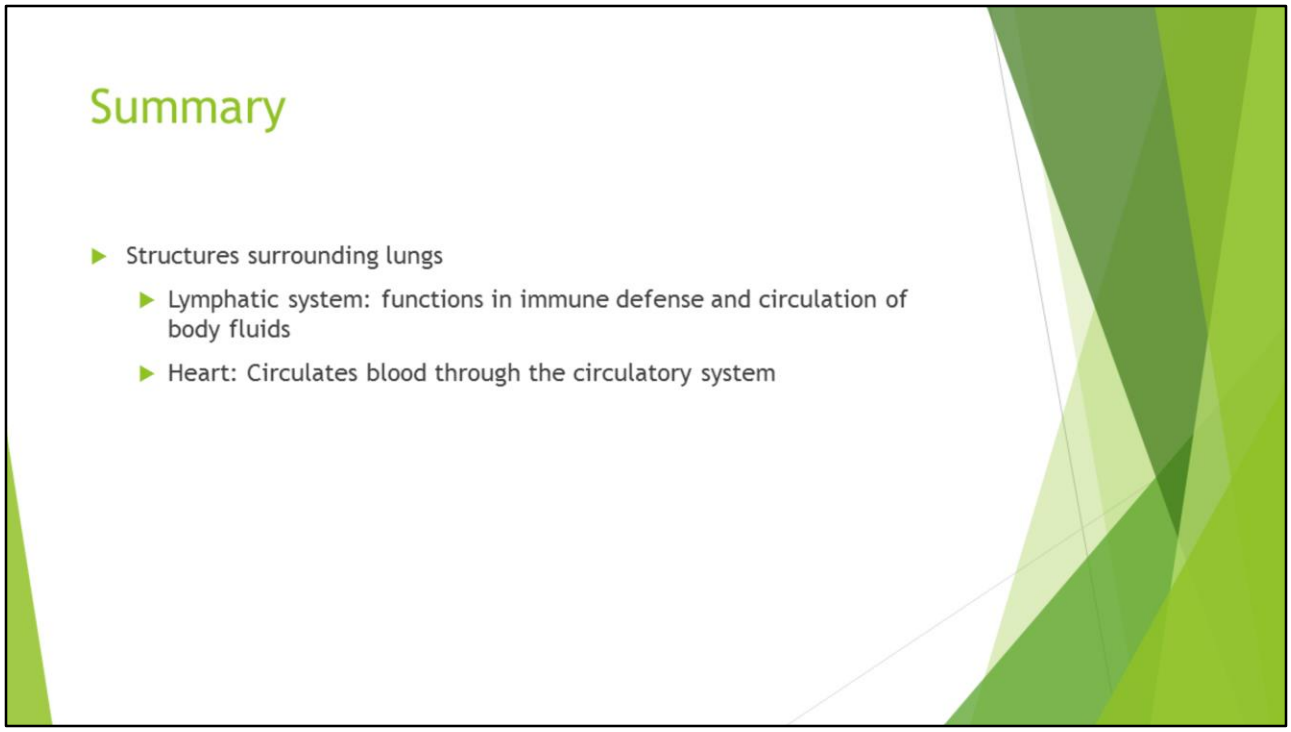
1. American Joint Committee on Cancer. Lung Cancer Staging, 7th ed. Available at: http://cancerstaging.org/references-tools/quickreferences/documents/lungmedium.pdf. Accessed December 12, 2015.
2. Betts JG, Desaix P, Johnson E. *Anatomy and Physiology.* OpenStax College. Rice University. 2013 Edition.
3. Heart. In: Morton DA, Foreman K, Albertine KH. eds. The Big Picture: Gross Anatomy. New York: McGraw-Hill; 2011. http://accessmedicine.mhmedical.com/content.aspx?bookid=381&Sectionid=40140010. Accessed February 15, 2014.



Before we turn to the progress check, let's take a moment to review key learnings from this short module:

The respiratory tract is divided into upper and lower segments. The upper includes nose to the larynx, while the lower includes all structures below, including the trachea, bronchi, and lungs. Each lung consists of lobes—3 on the right and 2 on the left; note that the left lung is slightly smaller than right to accommodate the heart.

The lower respiratory tract consists of the conducting zone, which simply conducts air, and the respiratory zone, which is the location of gas exchange in the alveoli.



Structures closely associated with lungs include the lymphatic system, which functions in immune defense and circulation of body fluids, and the heart, which circulates blood through the circulatory system.