

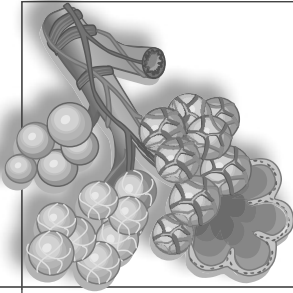
# The Human Respiratory System

BLG-5061-1  
Learning Guide



sofad





# **THE HUMAN RESPIRATORY SYSTEM**

**BLG-5061-1  
LEARNING GUIDE**

The Secondary V biology learning guides  
are published by SOFAD

***The Human Respiratory System***  
*The Human Reproductive System and the Perinatal Period*  
*The Transmission of Hereditary Characteristics*

The learning guides in this collection are adapted from the online courses of the same name which were produced first. The decision to produce both an online and a printed version of the same course was made to meet the requirements of those who do not have access to the Internet or who prefer to work with “paper,” in accordance with the need to diversify the tools and venues for distance learning.

# The Human Respiratory System

This learning guide was produced by the Société de formation à distance des commissions scolaires du Québec (SOFAD).

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## General Introduction

### ◆ The Biology Program

The Société de formation à distance des commissions scolaires du Québec (SOFAD) welcomes you to the course entitled *The Human Respiratory System*. This course is part of the Secondary V Biology Program for basic adult general education, which is comprised of the following nine courses:

- BLG-5061-1 *The Human Respiratory System*
- BLG-5062-2 *The Human Reproductive System and the Perinatal Period*
- BLG-5063-2 *The Human Digestive System*
- BLG-5064-2 *The Anatomy and Physiology of Cells*
- BLG-5065-2 *The Transmission of Hereditary Characteristics*
- BLG-5066-1 *The Human Skeletal and Muscular System*
- BLG-5067-1 *The Human Endocrine System*
- BLG-5068-2 *The Human Nervous System*
- BLG-5069-1 *Ecology*

Students who complete this 25-hour course can earn one Secondary V credit provided they pass a supervised examination administered by a Québec school board. There are no prerequisites for the courses in this program, and there is no equivalent program in the youth sector. The course's general objective is as follows: "By learning concepts of anatomy and physiology, adults will gain a better understanding of the human respiratory system, and the health problems associated with it."

### ◆ Using the Learning Guide

This learning guide is the main work tool for this course and has been designed to meet the specific needs of adult students enrolled in an individualized learning or a distance learning program.

The contents of this guide are divided into two main sections, which in turn are subdivided into modules, which are again subdivided into units. In each unit, the subject matter is presented in a number of ways (e.g. text, tables, illustrations, exercises) in order to facilitate mastery of the program objectives. In addition, at the end of each unit, just before the conclusion, you will be required to do a review activity in which all the main illustrations are shown in colour. By doing these exercises, you will be building an excellent summary of the entire course. Lastly, at the end of this guide you will find a conclusion, a self-evaluation activity and the corresponding answer key as well as an answer key for the exercises in the modules and appendices.

## Learning Activities

This guide includes theoretical sections as well as practical activities in the form of exercises. These exercises come with an answer key. Start by skimming through each part of this guide to familiarize yourself with the content and the main headings. Then read the theory carefully:

- ◆ Highlight the important points.
- ◆ Make notes in the margins.
- ◆ Look up new words in the dictionary.
- ◆ Study the diagrams carefully.
- ◆ Write down questions relating to ideas you don't understand. You can submit these questions to your instructor.

## Exercises

The exercises come with an answer key found at the end of this guide.

- ◆ Do all the exercises and, at the end of each module, quizzes.
- ◆ Read the instructions and questions carefully before writing your answer.
- ◆ Do all the exercises to the best of your ability without looking at the answer key.
- ◆ Reread the questions and your answers and revise your answers, if necessary. Then, check your answers against the answer key and try to understand any mistakes you made.
- ◆ Complete a module before doing the corresponding review exercises. Doing these exercises without referring to the lesson you have just completed is a better way to prepare for the final examination.

## Self-evaluation Activity

The purpose of the self-evaluation activity is to help you prepare for the final examination. Before you tackle the self-evaluation activity, reread your notes to ensure you have covered all the material pertaining to the learning objectives cited at the beginning of each module. Make sure you understand the learning objectives. Then do the self-evaluation activity without referring to the main body of the guide or the review exercises. Compare your answers with those in the answer key and review any areas you had difficulty with.

## Work Environment

Have all the materials you need close at hand.

- ◆ Learning materials: this guide and a notebook in which you will summarize important concepts relating to the learning objectives for each module.
- ◆ Reference materials: a dictionary.

- ◆ Miscellaneous materials: a calculator, a pencil for writing your answers and your notes on this guide, a coloured pencil for correcting your answers, a highlighter (or a pale-coloured felt marker) to highlight important ideas, a ruler, an eraser, etc.

### ◆ Evaluation

In order to earn the one credit for this course and towards your Secondary School Diploma, you must score at least 60% on a supervised examination dealing with the learning objectives outlined in this guide and administered in an adult education centre. The two-hour written examination counts for 100% of the final course mark.

### ◆ Succeeding at Distance Learning

#### Work Pace

A few tips for organizing your time are given below:

- ◆ Set up a study schedule that takes into account your availability, your needs and your family and work obligations.
- ◆ Try to devote a few hours a week to the course, preferably in blocks of two hours.
- ◆ As much as possible, stick to the schedule you have established.

#### Your Tutor

Your instructor is the person who will give you any help you need throughout this course. He or she is available to answer your questions and correct and comment on your assignments. Don't hesitate to contact your instructor if you are having difficulty with the theory or the exercises, or if you need some words of encouragement to help you get through this course. Information about how to contact your instructor that is not already contained in this guide will be made available to you. Write out your questions and get in touch with your instructor during his or her available hours. If necessary, write to him or her. Your instructor will guide you in your work and provide you with the advice, constructive criticism and support that will help you succeed in this course.

#### Homework Assignments

This guide is sold with two homework assignments designed solely for distance learning students. The homework assignments are to be completed at the end of the **second** and **fourth** modules in this guide. These assignments will show your tutor whether you understand the subject matter and are ready to go on to the next part of the course. If your tutor feels you are not ready to move on, he or she will indicate this on your homework assignments, providing comments and suggestions to help you get back on track. It is important that you read these corrections and comments carefully. Do your homework assignments without referring to the learning guide and take note of your tutor's corrections so that you can make any necessary adjustments. This is also an excellent way to prepare for the final examination.

*Remember not to send in the next assignment until you have received the corrections for the previous one.*

## ◆ The Human Respiratory system

The science of human biology is constantly evolving, and topics such as organ donation, artificial life support, plastic surgery, human cloning and new medical discoveries frequently generate headlines.

Most living beings breathe, and breathing means life! Respiration is one of the vital functions of the body. The functioning of all of the body's organs depends on proper oxygen and carbon dioxide exchange. Good respiration is essential to physical well-being.

Biology course 5061-1, *The Human Respiratory System*, will enable you to deepen your knowledge of the respiratory system and to learn more about the health problems associated with it. The following diagram illustrates the two sections of the course and shows the order in which the learning modules and the related activities are to be completed.

### Course Outline

<b>General Introduction</b>		
<b>Respiration</b>		
<b>Module 1</b> The Respiratory System	<b>Module 2</b> The Mechanics of Breathing	<b>Module 3</b> Gas Exchange
<b>Homework Assignment 1 (Modules 1 and 2)</b>		
<b>Health and Respiration</b>		
<b>Module 4</b> Respiratory Disorders		
<b>Homework Assignment 2 (Modules 3 and 4)</b>		
<b>General Conclusion</b>		
<b>Self-evaluation Activity</b>		

◆ **Reader's Comments**

**The Human Respiratory System** (June 2006)

You are about to read the second learning guide in SOFAD's Secondary V Biology program series. SOFAD is committed to providing course materials adapted to your needs, and we value your opinion. Please write your comments, questions or suggestions on this sheet, or contact us by phone, fax or email. If you find any errors, ambiguities, typographical errors, etc., we would appreciate hearing from you.

Thank you for giving us your feedback.

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Comments:

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From: \_\_\_\_\_

School Board: \_\_\_\_\_

Student:  Teacher:

Other:  Specify: \_\_\_\_\_





# Respiration



No organ in the human body can carry out its functions without oxygen. Breathing is essential to life. Inhalation and exhalation, two movements we repeat millions of times throughout our lives, allow oxygen to reach our cells and carbon dioxide to be eliminated.

When you reach the end of this section, you will be able to describe the organs involved in human respiration. You will be able to explain the mechanism of respiration and the exchange of gases that occurs in the lungs and tissues.

This section is subdivided into three modules:

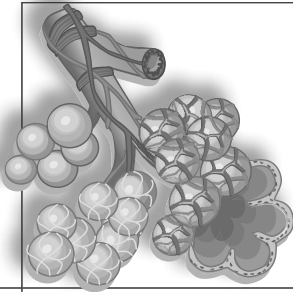
**The Respiratory System** describes the structure and the role of the different organs of the respiratory system.

**The Mechanics of Breathing** deals with the mechanism of respiration and the air volumes involved in respiration.

**Gas Exchange** describes the composition of air, the exchange of gases between the air and the blood and between the blood and the tissues, and the transport of oxygen and carbon dioxide.







## Module 1

# The Respiratory System

### ◆ Food for Thought

There is still a great need to educate the public about organ donation. Despite continuing advances in medicine and technology and the fact that we have some of the most skilled surgeons in the world, the demand for organs drastically exceeds the number of organ donors. The lungs are the only organs of the respiratory system that can be transplanted. Lung transplants involve taking lung sections from living donors or whole lungs from brain-dead donors whose heart is still beating. No organs are taken without the family's consent or the donor's consent as indicated by this person's signature on the back of the health insurance card. The shortage of transplant organs is due in part to these restrictions.

In your opinion, should organs be removed without the consent of the deceased person or his or her family if this is the only way to save someone's life?



## ◆ Learning Objectives

By the end of this module, you will be able to describe the human respiratory system.

More specifically, you will be able to:

- ◆ name the organs of the human respiratory system;
- ◆ identify, on a diagram, the different organs of the human respiratory system;
- ◆ describe briefly the organs of the human respiratory system;
- ◆ specify the role of each organ of the human respiratory system.

## The Organs of the Respiratory System

### ◆ Introduction

Human beings can survive for several weeks without food and for a few days without water, but they must have air to breathe. Like drinking and eating, **respiration** is essential to the body's **cells**. Without **oxygen**, which is provided through respiration and **blood circulation**, the cells could not carry out their functions and keep the body alive.

In this unit, we will explore the different organs of the **respiratory system**.

### ◆ Anatomy of the respiratory system

The respiratory system can be divided into three main sets of structures: the respiratory passages, the muscles involved in respiration, and the lungs. Learn about these three sets of structures and the organs of the respiratory system by dragging and dropping them into the right box.

The diagram shows a human torso with the respiratory system highlighted. Labels A through H point to various parts: A (Nasal cavity), B (Pharynx), C (Larynx), D (Trachea), E (Bronchi), F (Lungs), G (Respiratory passages), and H (Muscles). To the right is a list of parts to be dragged into the boxes:

- Muscles
- Nasal cavity
- Lungs
- Respiratory passages
- Trachea
- Larynx
- Bronchi
- Pharynx

*Validate with the answer key.*

The **pharynx** is a funnel-shaped tube about 13 cm long that connects the nasal cavity and the mouth to the esophagus and the larynx. It serves as a passage for air and food, and is generally referred to as the throat.

The **nasal cavity** is a space posterior to the nose that is divided lengthwise by a thin wall. At the front, the nasal cavity forms the nose, which is the only visible part of the respiratory system.

The **trachea** (commonly known as the “windpipe”) is a mobile, flexible tube about 12 cm long. It connects the larynx to the bronchi. This tube is composed of stacked C-shaped cartilage rings.

The **diaphragm** is the main muscle involved in respiration. It lies at the base of the lungs and forms the floor of the thoracic, or chest, cavity, separating it from the abdominal cavity beneath. Note that other muscles are involved in respiration, such as the elevator costal muscles and the intercostal muscles.

The **lungs** are two bulky pinkish masses which take up most of the space in the chest cavity. The right lung is divided into three lobes and the left lung has two lobes, leaving space for the heart. The lungs, which are the site of gas exchange, have a dual function: oxygenation and the elimination of carbon dioxide contained in the blood.

The **larynx**, or the “voice box,” is at most 5 cm long. It forms the junction between the pharynx and the trachea and houses the vocal cords. The larynx channels air and food towards the appropriate tubes: the esophagus for food and the trachea for air.

The **bronchi** (singular, *bronchus*) are the first two branches of the trachea. They are made up of cartilage rings. They enter the lungs and branch into bronchioles.

The **respiratory passages**, which consist of the nasal cavity, the pharynx, the larynx, the trachea and the bronchi, serve as conduits for channeling air into the lungs. The pharynx also serves as a passage for food, from the mouth to the esophagus.

### Recap

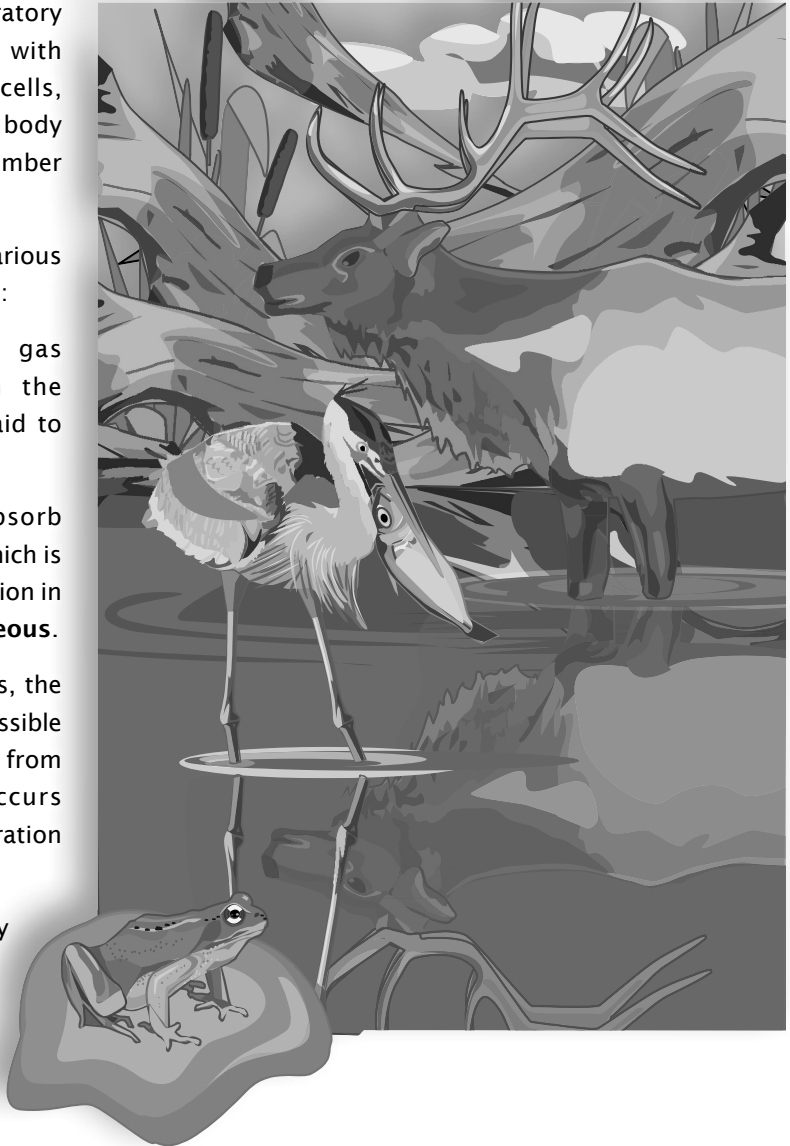
In order to understand the way the respiratory system works, it is important to be familiar with its constituent organs: the nasal cavity, the pharynx, the larynx, the trachea, the bronchi and the lungs. Without the diaphragm, which is the main muscle involved in respiration, oxygen could not be supplied to the body, and the lungs could not carry out their role of ensuring the exchange of gases.

## ◆ Different types of respiration

The main function of the respiratory system is to supply the body with oxygen, which is vital for the cells, and to expel waste gases. The body obtains oxygen in an amazing number of ways.

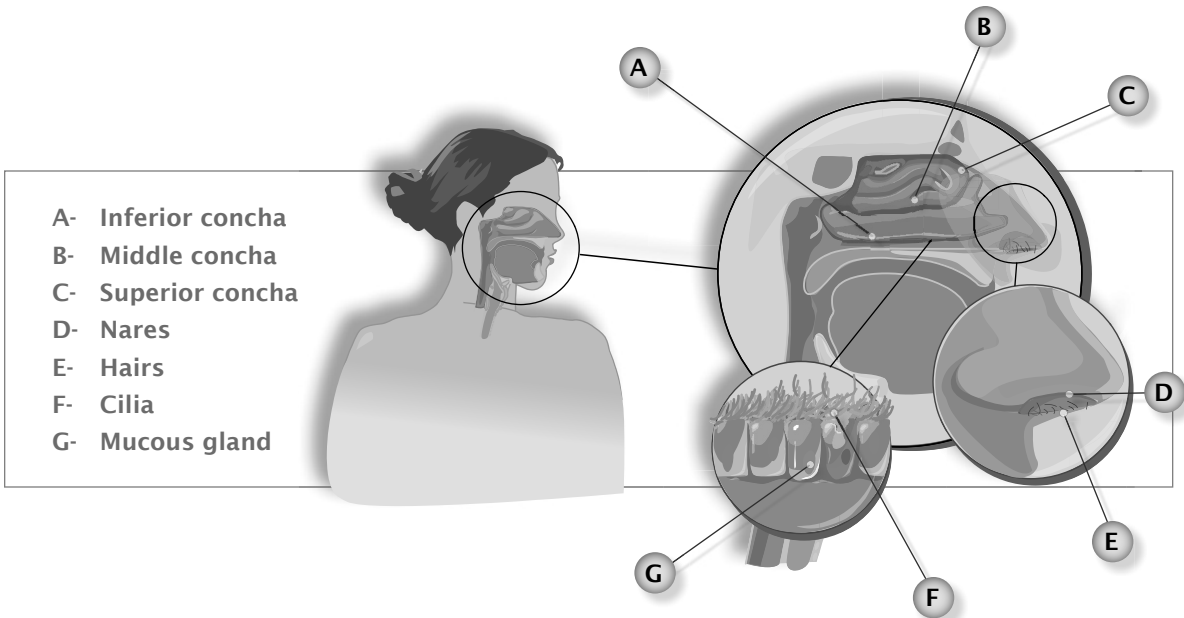
Respiration can occur through various organs. Here are some examples:

- ◆ In mammals and birds, gas exchange takes place in the lungs, and respiration is said to be **pulmonary**.
- ◆ Earthworms and frogs absorb oxygen through their skin, which is rich in blood vessels. Respiration in this case is said to be **cutaneous**.
- ◆ In fish and some crustaceans, the motion of the gills makes it possible to absorb dissolved oxygen from water. Gas exchange occurs through the gills, and respiration is said to be **branchial**.
- ◆ Some insects breathe by absorbing oxygen through the body wall. In most insects, however, air is carried through tiny air tubes called trachea. Respiration in this case is said to be **tracheal**.



## ◆ Inside the nasal cavity

The nose is a pyramid-shaped organ located centrally on the face, about a third of the way down. During inhalation, air passes through the nares, or nostrils, into the nasal cavity. Learn about the structures of the nose and their respective functions.



- A- The **inferior concha** is the lowest of the three conchae. It opens into the pharynx.
- B- The **middle concha** is rich in mucous glands and blood vessels. Air entering the nose is channeled towards this concha, where it is moistened and warmed.
- C- The **superior concha** is used for olfaction, that is, for perceiving smells (sense of smell). The olfactory receptors are situated in this concha.
- D- The **nares**, or nostrils, are the external openings of the nose; they allow air to pass into and out of the body.
- E- The **hairs** inside the nostrils serve to filter out dust and other impurities in the air.
- F- The **cilia** beat continuously in a wave-like motion that propels the mucus with its trapped debris toward the nasal cavity.
- G- The **mucous glands** produce mucus, a clear, viscous substance, which moistens, warms and partially filters the air. The mucus is a sticky layer that traps dust and other impurities as they are inhaled and prevents them from blocking the respiratory tree.

## Quick Check

1.1 Which part of the nasal cavity is responsible for olfaction?

- |  |  |
|--|--|
| <input type="checkbox"/> The middle concha | <input type="checkbox"/> The inferior concha |
| <input type="checkbox"/> The nostrils      | <input type="checkbox"/> The superior concha |

1.2 Which of the following is not a function of the nasal cavity?

- |   |   |
|---|---|
| <input type="checkbox"/> Moistens the air | <input type="checkbox"/> Allows gas exchange        |
| <input type="checkbox"/> Warms the air    | <input type="checkbox"/> Provides a passage for air |

*Validate with the answer key.*

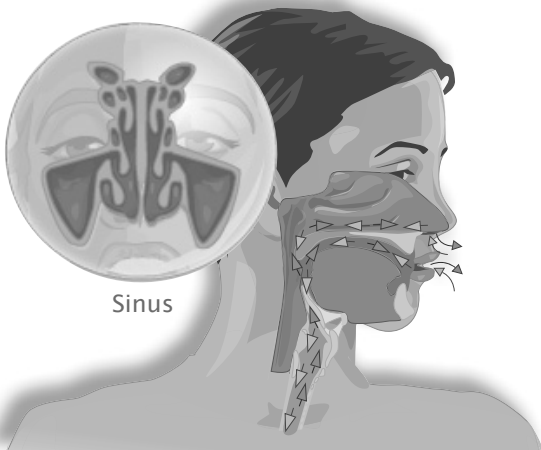
## Recap

The nasal cavity provides a passage for air during inspiration and expiration. This cavity is divided into passages by the nasal conchae: the superior concha, the inferior concha and the middle concha. The superior concha is used for olfaction and the other two are used for respiration. The middle and inferior conchae are lined with mucous glands and cilia that together serve to moisten, warm and filter incoming air.

### ◆ Through the mouth or through the nose?

*To have a nose for something, to nose around.* The English language has a number of expressions that allude to the **nose's** most obvious function: smell! However, the main function of the nose is to allow air to enter the body during **inhalation** and to leave the body during **exhalation**. Together with the sinuses, the nose also serves as a resonating chamber for the voice.

The sinuses also help to warm and moisten the air. Mucus produced by the sinuses traps the particles suspended in air and channels them to the nasal cavity. This mucus drains into the throat and can be emptied by blowing one's nose.





Humans breathe through the **mouth** as well as the nose. The air in the mouth is less warm and moist, and microbes and other particles in the air may enter the lungs, thus contributing to the development of certain respiratory illnesses. When our body needs a greater supply of oxygen such as during physical activity, or when we are congested, we tend to breathe through the mouth. The mouth serves as a resonating chamber, amplifying and raising the voice, but it also plays a key role in articulating words.



## ◆ Pharynx or larynx?

The larynx and the pharynx (commonly called the throat) are part of the upper respiratory tract together with the nasal cavity and the oral cavity. Place each of the following organ characteristics and names in the appropriate column of the table, depending on whether they are associated with the larynx or the pharynx.

Larynx 	Pharynx 	
-- <input style="width: 100%;" type="text"/>	-- <input style="width: 100%;" type="text"/>	A Epiglottis
-- <input style="width: 100%;" type="text"/>	-- <input style="width: 100%;" type="text"/>	B Respiratory and digestive tract
-- <input style="width: 100%;" type="text"/>	-- <input style="width: 100%;" type="text"/>	C Sound production
-- <input style="width: 100%;" type="text"/>	-- <input style="width: 100%;" type="text"/>	D Tonsils
-- <input style="width: 100%;" type="text"/>	-- <input style="width: 100%;" type="text"/>	E Vocal cords
-- <input style="width: 100%;" type="text"/>	-- <input style="width: 100%;" type="text"/>	F Uvula
-- <input style="width: 100%;" type="text"/>	-- <input style="width: 100%;" type="text"/>	G Adenoids
-- <input style="width: 100%;" type="text"/>	-- <input style="width: 100%;" type="text"/>	H Adam's apple

*Validate with the answer key.*

- A- The **epiglottis** is a small flap of cartilage that guards the entrance to the trachea (windpipe) during deglutition (swallowing), closing when anything is swallowed (e.g. food and saliva) that should go into the esophagus and stomach.
- B- This organ is divided into three parts. It channels air from the nasal cavity to the larynx, and food, from the mouth to the esophagus. This explains why it is both a **tract of the respiratory system** and a **tract of the digestive system**.
- C- In addition to serving as a passage for air (its only role in respiration), this organ plays a role in **phonation**, or the production of vocal sound. The vocal cords consist of two membranous folds supported by elastic ligaments that open to let air pass when we breathe. When the vocal cords move closer together, air from the lungs makes them vibrate, producing sounds.
- D- The main role of the **tonsils** is to protect the respiratory passages against infections. They are also involved in producing antibodies and are part of the immune system.
- E- There are **four vocal cords**, two upper and two lower. The upper cords are also known as “false vocal cords” because they play no role in phonation. The lower vocal cords are the only ones that vibrate when air from the lungs passes through the glottis (central conduit).
- F- The **uvula** helps to close off the nasal cavity during swallowing, thus preventing food from entering the airways.

- G- The **adenoids** are small glands located high in the throat that help filter out germs. Anything entering the nose comes in contact with them. By “sampling” viruses, they enable the body to develop antibodies to fight them. The pharyngeal tonsils (located at the back of the throat) are also called adenoids when they are swollen.
- H- The **Adam’s apple** is a more or less prominent cartilage mass that moves up and down when a person swallows. It is located at the front of the throat, just below the chin.

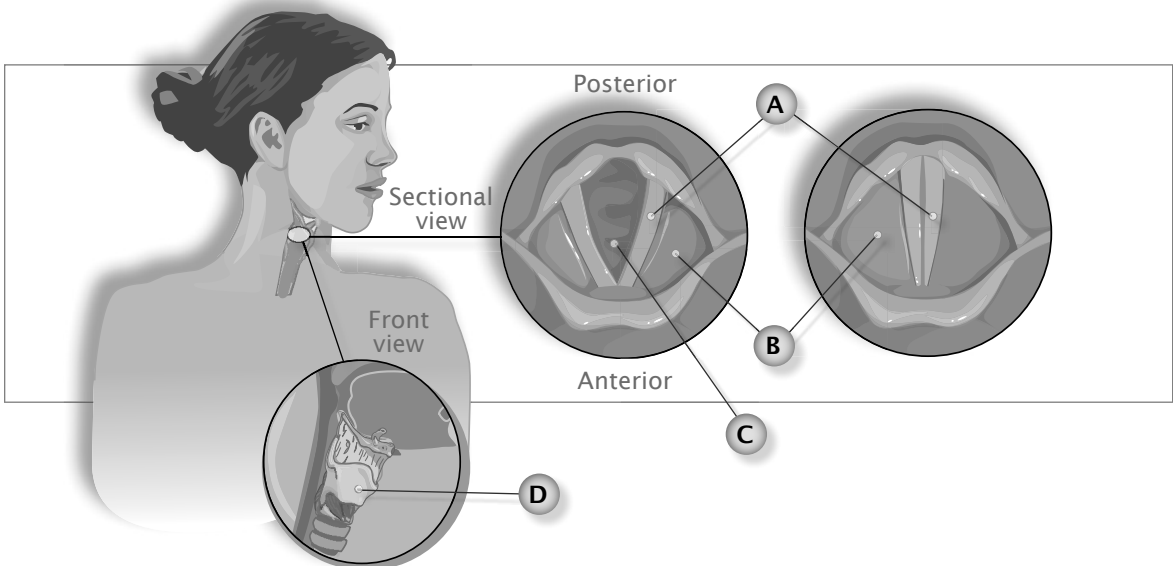
### Recap

The pharynx plays no particular role in respiration. It simply allows the air to pass from the nasal cavity to the larynx. The pharynx also serves as a passageway to the digestive system. The larynx allows only air to pass and also plays a role in phonation, or the production of vocal sound.

### ◆ Characteristics of the larynx

The larynx, commonly called the “voice box,” houses the vocal cords and forms the Adam’s apple.

The way the **vocal cords** work is simple. There are four vocal cords, of which two are true vocal cords (A) and two are false vocal cords (B). Only the lower, or true, vocal cords play a role in phonation. The muscles in the larynx control their opening and closing movements. When we speak, the vocal cords come together and vibrate as air from the lungs is forced between them through the **glottis** (C). The resulting vocal sounds are modified in the resonating chambers of the mouth and nose.



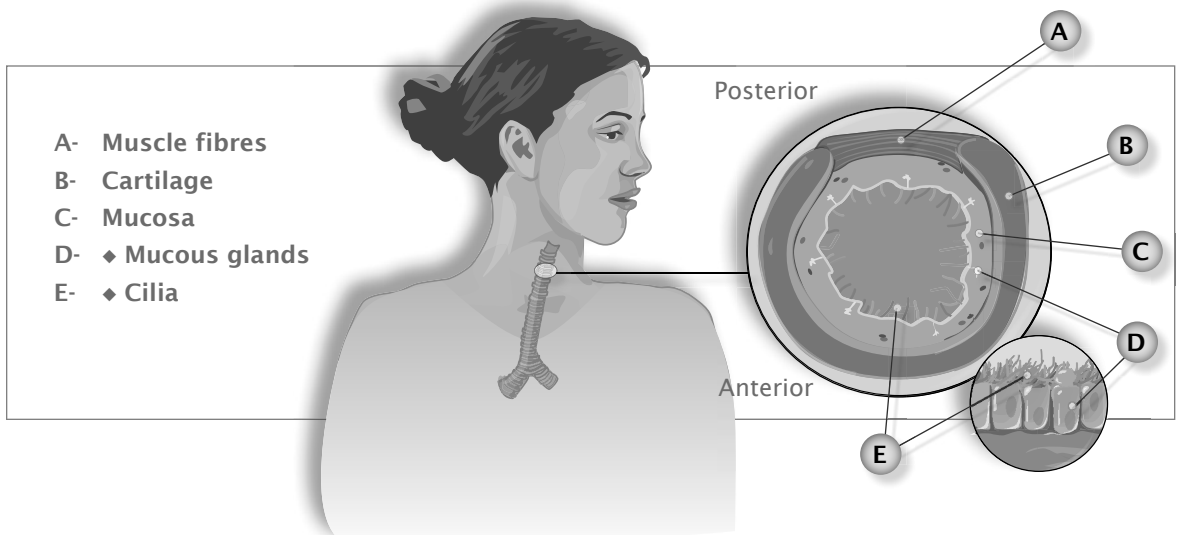
Sounds have very specific characteristics: volume, pitch and timbre. The volume may be loud or soft, depending on the force with which air passes through the vocal cords. The pitch (deep sounds, high-pitched sounds) depends on the thickness of the vocal cords. In men, the vocal cords are thicker, producing a deeper sound, whereas in women the vocal cords are generally thinner and shorter, producing a higher sound. Timbre is produced by the layering of sound waves produced by the different parts of the respiratory tract. This quality enables us to recognize someone's voice on the telephone.

The **Adam's apple** is a cartilage structure in the larynx (D) that can generally be seen at the front of the neck in men, and that moves up and down when we swallow.

While both men and women have an Adam's apple, it is generally more prominent in men, although it may not always be visible. This is due to the effect of the sexual hormone testosterone in men. The cartilage of the Adam's apple serves to protect a very important gland: the thyroid.

### ◆ The trachea

The trachea, or windpipe, is a tube about 2.5 cm in diameter and 11 cm long that begins at the larynx and divides into two primary bronchi, one leading to each lung. Learn about the structures of the trachea.



- A- The posterior side of the trachea is lined with a layer of smooth **muscle fibres**. By contracting or expanding, these fibres increase or decrease the airways' resistance to the passage of air. The muscle fibres contract when we cough, helping to expel mucus to the respiratory passages.
- B- The trachea is kept open by C-shaped **cartilage** rings that resemble the metal rings of some vacuum cleaner hoses. These rings prevent the trachea from collapsing as air pressure changes occur during the breathing cycle.
- C- The internal **mucosa** lining the trachea is composed of mucous glands and cilia (hair-like

projections) that have a wave-like motion; the mucosa plays an important role in cleaning, warming and moistening the air.

- D- The **mucous glands** secrete mucus, which lubricates the trachea and traps foreign particles that are inhaled. These glands also play an important role in moistening the air.
- E- The upward beating of the **cilia** helps to move any foreign material or excess mucus along the trachea toward the pharynx, where it can be expelled.

### Quick Check

1.3 What is the role of the ciliated cells lining the trachea?

- They prevent the trachea from collapsing.
- They make it easier for food to descend into the esophagus.
- They produce mucus.
- Their beating or wave-like motion helps expel foreign particles.

1.4 The structures that form the trachea are the mucosa, the cilia, cartilage rings and

- muscle fibres.
- the esophagus.
- the epiglottis.
- the throat.

*Validate with the answer key.*

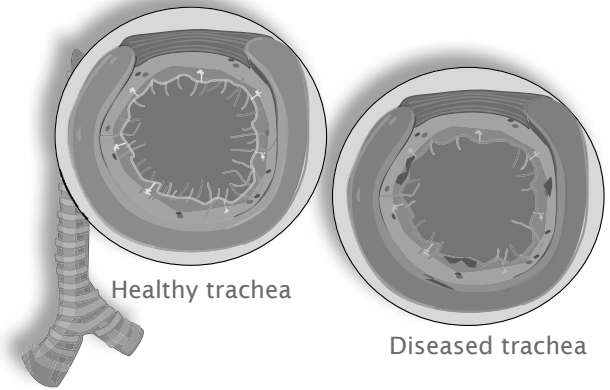
### Recap

The anterior part of the trachea is composed of C-shaped cartilage rings and the posterior part consists of muscle fibres. The role of the trachea is to channel air toward the lungs and to clean, moisten and warm the air through the combined action of the mucus and the cilia.

### ◆ Say no to cigarettes

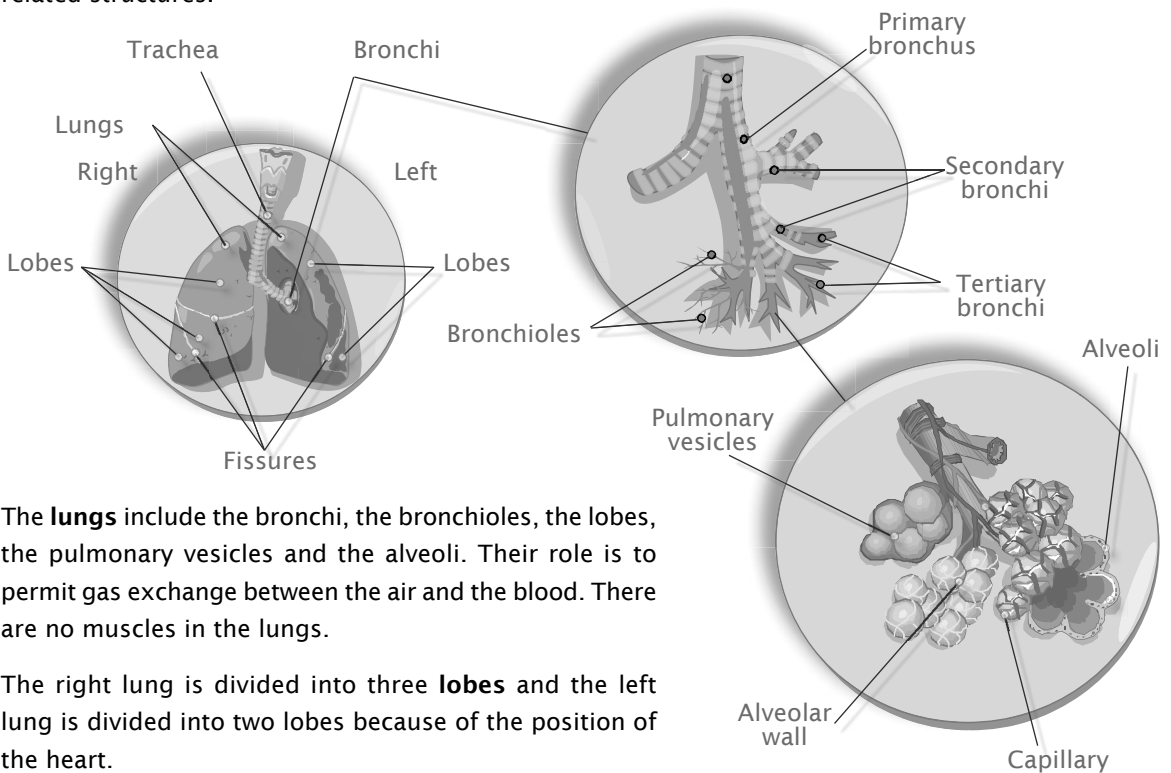
Smoking can impair the wave-like motion of the **cilia** (hair-like projections) in the trachea and can even destroy them. Once the cilia are destroyed, they no longer perform their role of moving the mucus with its trapped germs and dust up the trachea so that it can be expelled. Hacking, or smoker's cough, results from the need to clean the obstructing mucus from the airways and keep it out of the lungs. Because this coughing is a natural means of defence, it is not a good idea to give a smoker cough medication.

The toxic substances in cigarettes (benzopyrene, tar, etc.) directly alter the **mucosa** of the larynx and the trachea by changing the morphology of these tissues. In addition, tobacco smoke raises the air temperature inside the larynx from 37°C to 42°C. The result is microburns in the mucosa, or chronic traumatic thermal **lesions**. **Smoking** is considered to be one of the main causes of **cancer**, and more specifically, of cancers of the trachea and larynx.



## ◆ Organization of the lungs

Children's lungs are pinkish in colour, and adults' lungs are grayish pink. At maturity, each lung has a volume of more than 2 litres. Explore the different structures of the bronchial tree and some closely related structures.

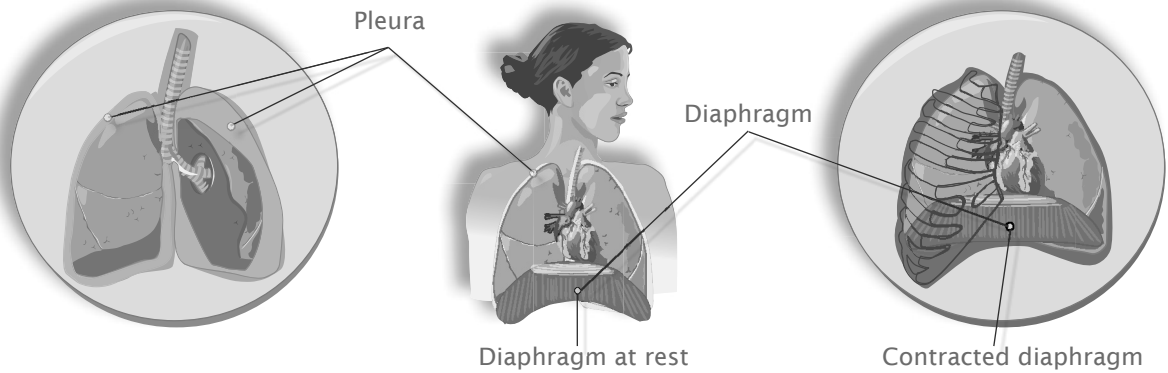


The **lungs** include the bronchi, the bronchioles, the lobes, the pulmonary vesicles and the alveoli. Their role is to permit gas exchange between the air and the blood. There are no muscles in the lungs.

The right lung is divided into three **lobes** and the left lung is divided into two lobes because of the position of the heart.

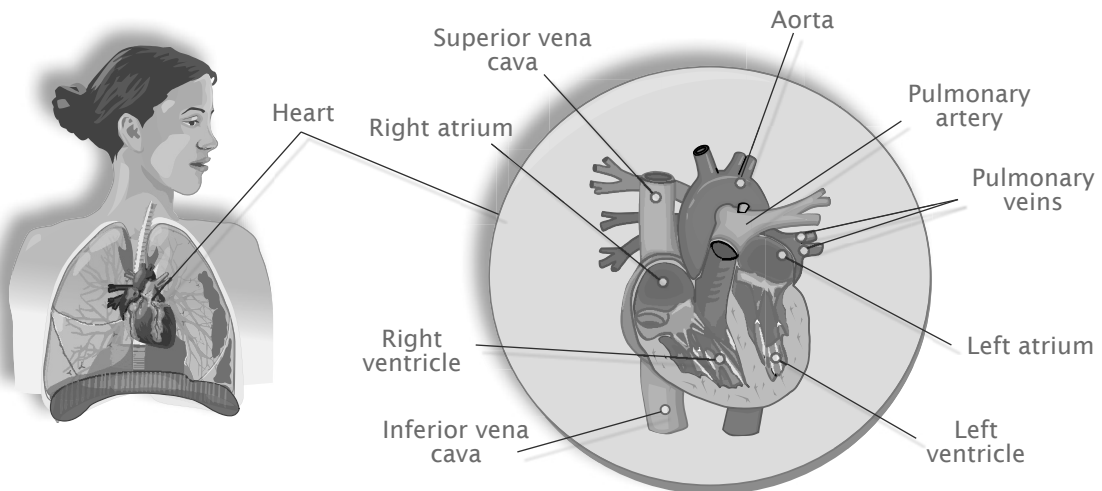
The **bronchi** are made of cartilage and are lined with cilia (hair-like projections) and mucus that help clean the air. Their role is also to convey, warm and moisten the air. Before entering the lungs, the trachea divides into the left and right **primary bronchi**. The primary bronchi divide into smaller tubes called the **secondary bronchi**, one for each lobe of the lungs. These further divide into even smaller conduits called the **tertiary bronchi**, which branch into **bronchioles**.

The **pulmonary vesicles**, also known as alveolar sacs, resemble bunches of grapes and are located at the end of the bronchioles. They contain many alveoli. Embedded in the walls of the alveoli (tiny cavities that are the final destination of inhaled air) are capillaries where the exchange of gases occurs by diffusion. There is no mucosa in the alveoli.



The **pleura** is a **double membrane** that surrounds the lungs. The **pleural fluid** acts as a lubricant between the two membranes, preventing friction between the lungs and the rib cage.

The **diaphragm** is one of the main muscles involved in respiration. It lies at the base of the lungs. The diaphragm contracts during inhalation and expands during exhalation. The diaphragm plays a more important role in men than in women during respiration.



The **heart** is the main muscular organ of the circulatory system. Although it is not part of the respiratory system, the two systems work closely together. The heart lies between the lungs and the middle of the chest cavity (thorax). It works like a pump, and each side of the heart functions separately. The left side receives oxygenated, or oxygen-rich, blood and pumps it throughout the body, while the right side channels deoxygenated, or oxygen-poor, blood to the lungs, where wastes are removed and the blood is once again oxygenated.

## Quick Check

1.5 The lungs are the organs in which the exchange of gases occurs. Which structure is not part of the lungs?

- |   |  |
|---|--|
| <input type="checkbox"/> The pulmonary vesicles | <input type="checkbox"/> The bronchioles |
| <input type="checkbox"/> The heart              | <input type="checkbox"/> The alveoli     |

1.6 What role do the bronchi play?

- |  |  |
|--|--|
| <input type="checkbox"/> Permit gas exchange | <input type="checkbox"/> Clean, moisten and warm the air |
| <input type="checkbox"/> Protect the lungs   | <input type="checkbox"/> Produce sounds                  |

*Validate with the answer key.*

## Recap

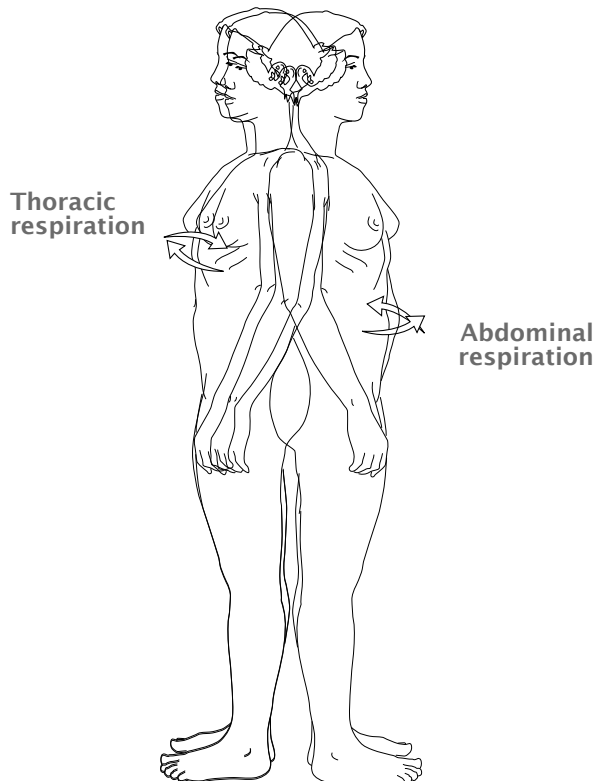
The exchange of gases occurs in the lungs, which are encased in a protective double membrane called the pleura. The diaphragm is one of the main muscles involved in inhalation. The bronchial tree is composed of primary bronchi, secondary and tertiary bronchi, bronchioles and alveolar sacs.

## ◆ Thoracic or abdominal?

Did you know that humans breathe in different ways depending on their age, sex and situation? There are two types of breathing: thoracic respiration and abdominal respiration (also called diaphragmatic respiration).

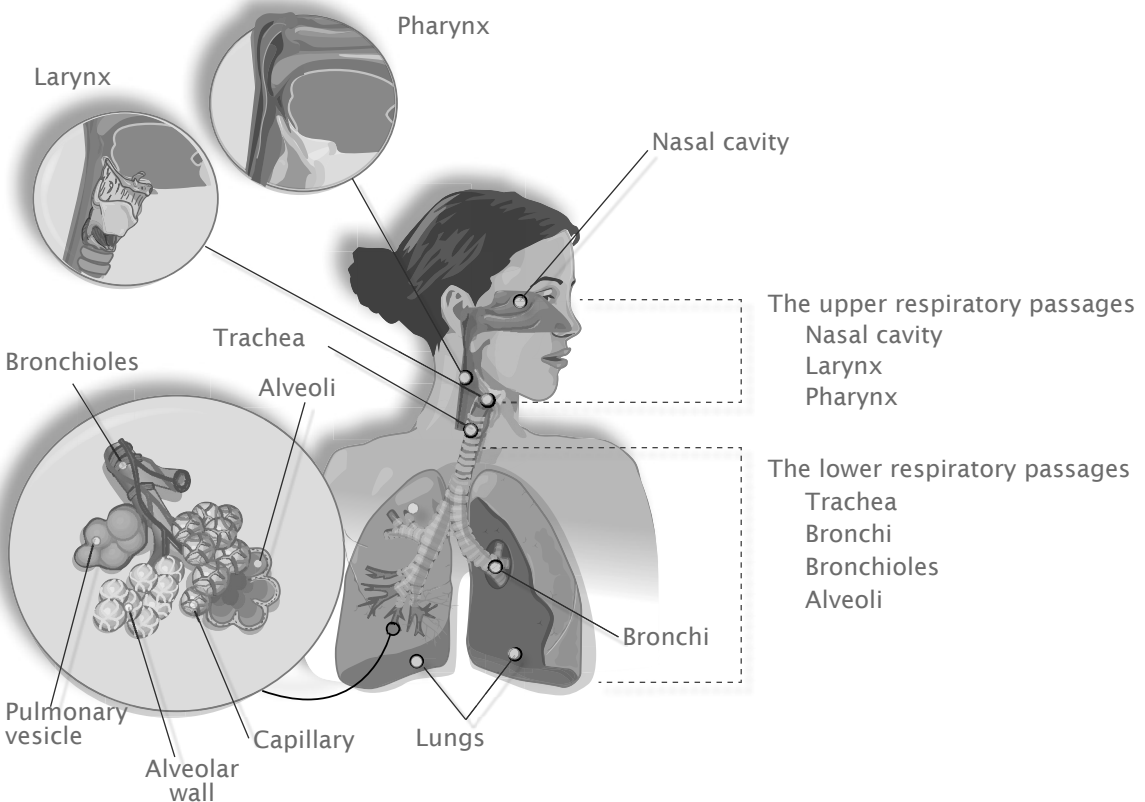
**Thoracic respiration** (chest breathing) is characterized by swelling of the thoracic cavity with the help of the chest muscles. This type of respiration is related to our emotions, our feelings, the heart. Think of a deep sigh!

**Abdominal respiration** is characterized by lowering of the diaphragm, relaxation of the abdominal muscles and dilation of the belly. Babies, young children and sleepers breathe this way.



◆ **Conclusion**

The organs of the respiratory system can be divided into two main groups: the upper respiratory tract (the nasal cavity, the larynx and the pharynx) and the lower respiratory tract (the trachea, the bronchial tree and the lungs). The ultimate function of the respiratory passages is to channel the oxygen contained in the air to the lungs. The alveoli are the sites of oxygen exchange between the lungs and the blood.



**End of unit**

Before you continue, go to the “Unit Summaries” section and complete the corresponding review activity.



◆ **What I Know Now**

At the beginning of this module, you answered a question about the learning content of the unit to the best of your knowledge. Here is the same question. Answer it again, then compare your answer to your previous one.

Air enters the respiratory system through the nose or mouth and travels to the lungs. Can you name the organs of the respiratory system that are situated between the nose and the lungs?

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◆ **Take a Stand**

In this unit, you learned about the different organs of the respiratory system and the role each one plays. You also saw that, without the lungs, human life is impossible.

In your opinion, should organs be removed without the consent of the deceased person or his or her family if this is the only way to save someone's life?

Yes

No

I don't know

◆ Quiz

1. In which part of the respiratory system does gas exchange take place?
  - A. The bronchi
  - B. The trachea
  - C. The lungs
  - D. The larynx
2. Which organ constitutes the junction of the digestive and respiratory tracts?
  - A. The pharynx
  - B. The larynx
  - C. The trachea
  - D. The nasal cavity
3. Which organ is not part of the respiratory system?
  - A. The heart
  - B. The bronchi
  - C. The nasal cavity
  - D. The larynx
4. Which of the following structures does not belong to the nasal cavity?
  - A. The inferior concha
  - B. The cilia
  - C. The mucous glands
  - D. The epiglottis
5. Which organ of the respiratory system can be described as a tube made of cartilage rings?
  - A. The pharynx
  - B. The trachea
  - C. The larynx
  - D. The bronchi
6. Which of the following structures is not part of the lungs?
  - A. The alveoli
  - B. The bronchioles
  - C. The pulmonary vesicles
  - D. The diaphragm

7. How many lobes does the left lung have?
  - A. 1
  - B. 3
  - C. 2
  - D. 5
  
8. Which organs are lined with mucus-producing cilia?
  - A. The nasal cavity, the trachea, the bronchi, the bronchioles
  - B. The nasal cavity, the larynx, the bronchi, the alveoli
  - C. The trachea, the bronchi, the bronchioles, the lungs
  - D. The larynx, the pharynx, the trachea, the lungs
  
9. Which structure protects the lungs?
  - A. The diaphragm
  - B. The pleura
  - C. The pharynx
  - D. The heart
  
10. Where are the vocal cords located?
  - A. In the nasal cavity
  - B. In the trachea
  - C. In the pharynx
  - D. In the larynx

*Validate with the answer key.*

