

INVESTIGATING
Body Systems

Investigating the

RESPIRATORY SYSTEM



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Crabtree
Forest

Contents

Introduction

The Respiratory System at Work 4

Chapter 1

How Do We Know? 8

Chapter 2

How It Works 12

Chapter 3

When It Doesn't Work 26

Chapter 4

Keeping the System Healthy 34

Chapter 5

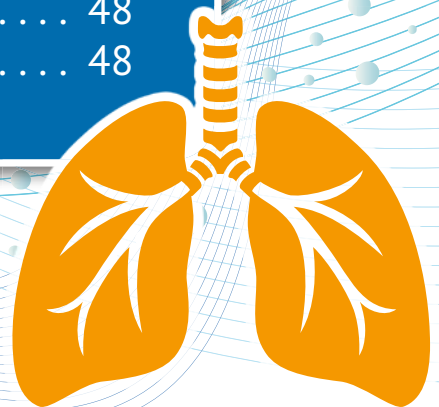
Looking to the Future 40

Glossary 46

Learning More 47

Index 48

About the Author 48



The Respiratory System at Work

Your soccer game is in full swing. You are sprinting across the pitch to take a pass from a teammate. When you head to the bench you are out of breath, sweating, and your heart is pounding. These are all signs of your respiratory system at work. Breathing and respiration are the two processes that make up this system. Breathing takes oxygen into your body to transfer it into the blood. Respiration happens in the cells where oxygen, or the gas we breathe, is exchanged or made into another gas called carbon dioxide.

Every living thing needs to breathe: plants, **microbes**, and animals, including humans. Insects breathe through holes in their bodies. Fish take in oxygen from water through their gills. Mammals, adult **amphibians**, birds, and reptiles use lungs. Animals take in oxygen and give off carbon dioxide. Plants exchange gases the opposite way to animals. They take in carbon dioxide and give off oxygen. That is why it is vital to keep a balance between plants and animals, and forests and cities.

For everything we do in life, every move we make, even in sleep, we have to breathe. By the time we are 70, we will have taken about 600 million breaths. Our lungs are the organ we use to breathe, but they are only part of the system that allows our body to use oxygen to live, move, and grow. Breathing in is called inhaling. Breathing out is called exhaling.

How Much Do We Breathe?

The average person takes around 17,000 breaths per day. The air we inhale is about 21 percent oxygen and 78 percent nitrogen. Our bodies do not use nitrogen, so we just breathe it back out again. We also exhale about 2 cups (0.5 L) of water each day. That is why you should make sure you drink enough water daily to replace it.



Inhale and Exhale

In order for the respiratory system to work, it has to have a way to bring air into the body and a place to store it for a while. Then it has to have a way to remove the oxygen the body needs from the stored air and replace it with carbon dioxide that it doesn't need. Lastly, it has to **expel** the unnecessary gases from the body.

The lungs are the main organ of the respiratory system. They are the storage area for inhaled air. They are a little like two balloons in your chest. When you inhale, the balloons fill up. When you exhale, they **deflate**. You can feel that movement if you put your hands on your chest. You also know your respiratory system is working on cold days when you

can see your breath as you exhale. That is because the water droplets in exhaled air cool down outside the body and form a mist.

Our breathing changes over our lifetime. Newborn babies breathe from 40 to 60 times per minute. This is because their lungs take up a large portion of their chest. There isn't as much room for them to store air in between breaths. As they grow, that space increases and the average breaths decrease. Adults breathe about 16 times per minute. Both adults and babies breathe more slowly when asleep. When we are afraid or worried we breathe much more quickly—for adults, up to 100 times per minute.

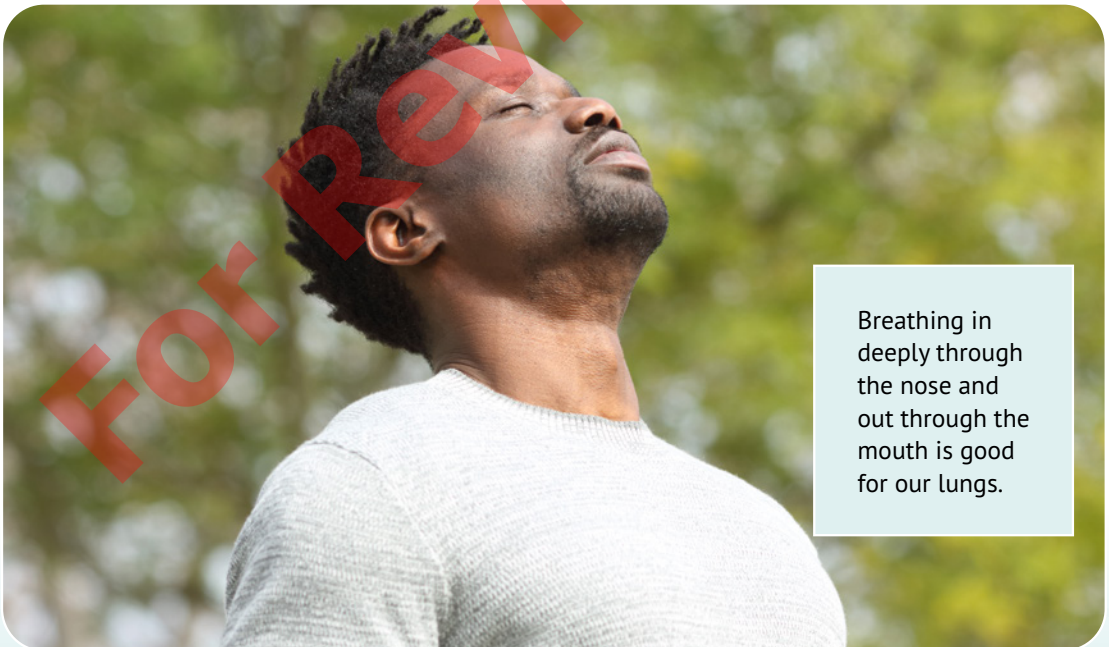
A baby's breathing decreases as they grow, from 40 to 60 breaths a minute as newborns to 25 to 40 a minute at six months.





Snoring

Snoring is the loud sound that sometimes happens when people sleep. Air **flows past** tissue in the throat, causing the **tissue** to **vibrate** with each breath. The loudest **snore ever** recorded was about 112 decibels. That is as loud as a jet flying right over your house!



Breathing in deeply through the nose and out through the mouth is good for our lungs.

How Do We Know?

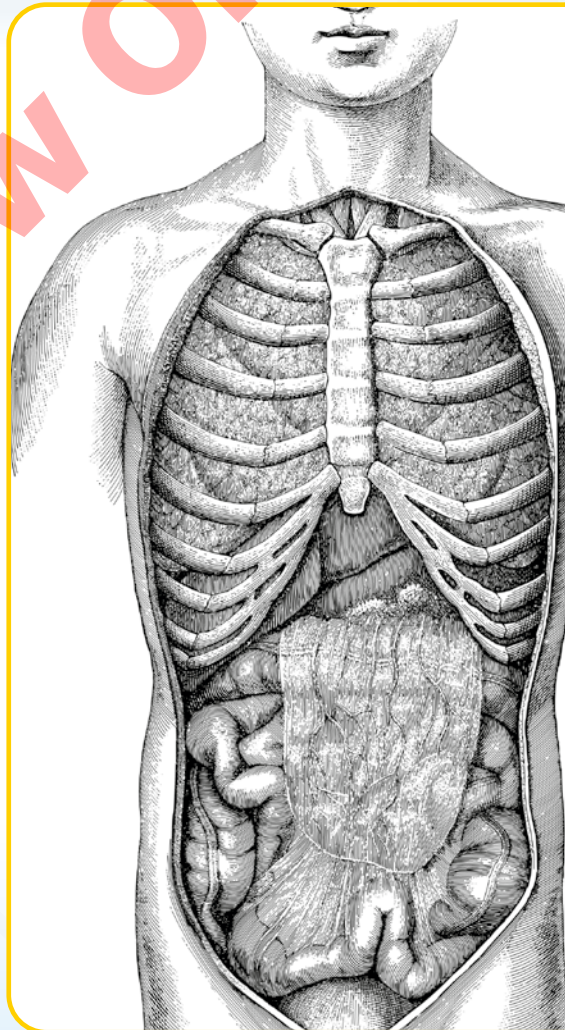
Healers and physicians in ancient times did not know the purpose of breathing. They also didn't know at first that breathing was connected to the lungs.

Lungs and breathing were first mentioned together in a record written by the ancient Greeks in about 384 to 322 B.C.E. At the time, people thought that the role of breathing was to cool the heart and that most of the process happened through pores in the skin.

The first person to suspect that a vital substance is taken from air during breathing and transported in the blood to the heart was Galen. He was a Greek physician working in the **Roman Empire** around 150 C.E. Galen examined the human body when he did surgeries and **autopsies**. He was the first to understand that the **diaphragm** was used to help the lungs expand and **contract**.

Understanding that the heart and lungs work together came next. Ancient texts describe how the heart pumps blood that has come in contact with air around the body. Researchers can trace this idea back to Qusta ibn Luqa, who was born around 860 C.E. in Baalbek in what is now modern Lebanon.

In the Middle Ages, from 500 to about 1500 C.E., scientists were forbidden by the Christian Church to open bodies and investigate. Because of this, our knowledge of the human body and how it worked stalled for centuries.





A polio patient in an iron lung at a hospital in 1940. Polio sometimes weakened the muscles used to inhale and exhale. An iron lung assisted respiration. Some patients used them for a few weeks or months. Others needed them all the time.

The heart and lungs are protected by the rib cage.

The Iron Lung

The iron lung is a machine that was invented by Philip Drinker and Louis Agassiz Shaw in 1928. They wanted to help children who were paralyzed from **polio** and unable to breathe. The machine is a large metal tube that surrounds a person's body, except for the head. Using pressure, it mechanically helps their chest to rise and fall, forcing air in and out, allowing them to breathe.