THE RESPIRATORY SYSTEM
from
The Human Body Systems Series

Teacher's Guide
THE RESPIRATORY SYSTEM
Grade Levels: 6 - 9
(Review for grades 10-12)
Viewing Time: 20 minutes with video quiz

INTRODUCTION

This video is designed for use in grades 6 - 9 as an introduction to the major ideas and concepts associated with the human respiratory system, and for use in grades 10-12 as review.

PROGRAM OBJECTIVES

After viewing the video and participating in the lesson activities, the students will be able to …

• Describe the function and workings of the respiratory system.

• Identify the main parts of the respiratory system.

• Describe how gas exchange takes place in the human body.

• Recognize the importance of a healthy respiratory system.

• Define key vocabulary terms associated with the respiratory system.

SUMMARY OF THE VIDEO

This video describes the human respiratory system. It introduces key vocabulary related to understanding how the respiratory system helps to provide the body with the ability to oxidize food and obtain energy for all the trillions of living cells found within a human. Through the use of colorful computer graphics, 3D animation, and live-action video, students are presented with the respiratory system.
INSTRUCTIONAL NOTES

Before presenting this lesson to your students, we suggest that you preview the video and review this guide and the accompanying blackline master activities in order to familiarize yourself with their content.

Duplicate any blackline masters you wish to distribute. If you plan to use the Video Quiz, which immediately follows the video presentation, you may wish to distribute Blackline Master 1, Video Quiz, before showing the video.

Blackline Master 5, Lung Capacity is an experiment for which you will need the following supplies: large jugs, (such as water bottles), 1,000 ml graduated cylinders, grease pencils, water, tubing, soda straws, and large pans for inversion of jugs. You may want to have these supplies and your laboratory prepared before beginning this experiment.

As you review the materials presented in this guide, you may find it necessary to make some changes, additions, or deletions to meet the specific needs of your class. We encourage you to do so, for only by tailoring this program to your class will they obtain the maximum instructional benefits afforded by the material.

It is also suggested that the video presentation take place before the entire group under your supervision. The lesson activities grow out of the context of the video; therefore, the presentation should be a common experience for all students.
INTRODUCING THE VIDEO

Ask students to take a deep breath and hold it for as long as they can. After a couple of minutes, everyone will be gasping for breath. Why couldn’t we go for more than a couple of minutes without air? We can go days without food and water. Why can’t we be without air for even a couple of minutes? The video you will be watching today will help to explain the importance of the respiratory system which supplies our living bodies with the much-needed oxygen found in air.

Present the video. The viewing time is 14 minutes for the program and about 5 minutes for the Video Quiz.

BLACKLINE MASTER DESCRIPTIONS

Most of the follow-up activities for this program are designed for middle school grades. If you use this program with an older audience, you will need to adapt the materials appropriately.

Blackline Master 1, Video Quiz, is to be used at the end of the video program. At the completion of the video, there is a short ten-question quiz. The narrator will read the questions which are displayed on the screen. Students can use this sheet to record their answers. Answers to the questions are provided in the Answer Key found on page 5.

Blackline Master 2, Vocabulary, is a collection of important vocabulary words from the video. You may want to distribute this sheet before viewing the video so students can listen for definitions.

Blackline Master 3, Parts of the Respiratory System, contains a diagram of the respiratory system. Students are to label the various parts of the system with the terms in the...
Blackline Master 4, Breathing, asks students to describe what is happening during inhaling and exhaling. Students should talk about the roles played by the diaphragm and rib muscles in helping us to breathe. Changes in air pressure should also be discussed.

Blackline Master 5, Lung Capacity, is an experiment that will demonstrate the lung capacity of people based on the amount of water they can displace when exhaling into a large jug of water. Supplies are detailed in the Instructional Notes section of this guide.

Blackline Master 6, Quiz, is the formal test for this unit of study.

INTERNET ACTIVITIES


2. The Pulmonary Pathology Index published by the University of Utah at http://www-medlib.med.utah.edu/WebPath/LUNGHTML/LUNGIDX.html is not for the faint of heart, but contains great photgraphic images in all states of health and is a great way to impress students with the importance of pulmonary health.

DISCUSSION QUESTIONS

1. In 1943 Jacques Cousteau invented SCUBA tanks for underwater breathing. Does anyone know what SCUBA stands for? (Self-contained underwater breathing apparatus)
2. Discuss the role mucus plays in helping to keep clear air passages.

3. Discuss some of the harmful effects of cigarette smoke and the damage that can result to the respiratory system.

ANSWER KEY

Blackline Master 1, Video Quiz
1. c 6. a
2. b 7. b
3. a 8. d
4. c 9. d
5. d 10. a

Blackline Master 2, Vocabulary
1. respiration - the release of energy in cells by the combination of food and oxygen
2. gills - organs used by water animals to obtain oxygen from the water
3. spiracles - holes along the abdomen of insects used to take in oxygen
4. carbon dioxide - a gaseous waste product of respiration which is exhaled from animals
5. mucus - a sticky substance produced by the nose to moisten the inhaled air and trap dust and bacteria
6. cilia - microscopic hairlike structures that help move mucus and other substances in the respiratory track
7. esophagus - the tube leading to the stomach from the throat
8. trachea - the tube that leads to the lungs from the throat
9. epiglottis - a flap that covers the trachea while food is swallowed; this prevents food from going into the trachea and lungs
10. larynx - the part of the throat that contains the voice box or vocal cords
11. bronchi - the main branches of the respiratory tract leading into the lungs
12. **alveoli** - tiny sacs at which gas exchange takes place in the lungs

13. **diaphragm** - a muscle on the underside of the lungs; when it contracts and relaxes, it sets up the conditions of low and high air pressure that permit air to be inhaled and exhaled from the lungs

**Blackline Master 3, Parts of the Respiratory System**

**Blackline Master 4, Breathing**

**Exhaling** - The diaphragm relaxes and takes on its dome shape. The rib muscles relax and the chest cavity becomes smaller. This creates less room for the lungs, which are pushed inward. The air in the lungs has greater pressure than the outside air, so air leaves the lungs until the pressure balances.

**Inhaling** - The rib muscles and diaphragm are signaled to
contract. The rib muscles pull the chest cavity up and out while the diaphragm moves downward. This creates more space for the lungs and a condition of less pressure. There is less pressure in the lungs than outside the body. Air from outside move into the lungs because of this imbalance in air pressure.

**Blackline Master 5, Lung Capacity**
The results will vary with individual students. It may be interesting to have the entire class record their results and then make comparisons between all participants. This could become a great opportunity for using graphing skills.

**Blackline Master 6, Quiz**
1. The respiratory system is designed to obtain oxygen from the air and remove the waste product carbon dioxide from the body.
2. Respiration is the combining of food and oxygen to release energy in cells.
3. Air is taken into the nose or mouth and travels into the throat. In the throat, there are two separate paths or tubes. The esophagus leads to the stomach and the trachea leads to the lungs. The air travels into the trachea and down into the bronchial tubes, which divide off into the left and right lungs. The bronchial tubes divide into smaller and smaller tubes until eventually the smallest branches lead to clusters of sacs called alveoli. There are about 600 million of these little sacs at which the exchange of gases takes place. Oxygen from the air is released to the hemoglobin in the blood and the waste gas carbon dioxide, which is a by-product of respiration in the cells, is released into the lungs. The carbon dioxide will be exhaled. The oxygen-rich blood will circulate throughout the body in which the oxygen is eventually released to cells.
4. The diaphragm is a bell-shaped muscle found below the chest cavity and lungs. When the muscle is given the signal to contract, it flattens out, creating a larger area in the
chest cavity. This results in a space of low air pressure. The air outside the lungs rushes in to fill up the area of low pressure. When the diaphragm relaxes, it moves back to its normal bell-shaped position, which causes the chest cavity to shrink and push air out of the lungs.

5. The mucus in the nostrils moistens the air so that it doesn’t dry out the internal parts of the respiratory system. It also catches dust and bacteria.

6. People sneeze if the particles caught in the mucus of the nasal cavity irritate the nose.

7. The epiglottis is a flap found above the trachea. During swallowing, this flap covers over the opening of the trachea so that food won’t go into the tube leading to the lungs.

8. The alveoli are the tiny sacs at the ends of the tubes that run throughout the lungs. Oxygen and carbon dioxide are exchanged in the alveoli. Blood capillaries surround the sacs. Blood returning from the body is sent to the lungs from the right ventricle of the heart. When the blood gets close to the alveoli, the waste gas carbon dioxide is released to the sac. Oxygen is released to the blood in the capillary and is then taken to the right atrium of the heart to eventually be pumped throughout the body.

9. Tar is extremely damaging to the lungs. It can clog passageways and kill cilia. Another chemical released in cigarette smoke is carbon monoxide. This gas takes the place of oxygen in the blood. This means less oxygen is transported to the cells and tissues of the body.

SCRIPT OF VIDEO NARRATION

THE RESPIRATORY SYSTEM

Your body is made up of trillions of living cells. Each of these cells needs energy to carry out the various tasks that keep our bodies alive and functioning. The circulatory system delivers food that has been broken down by the digestive system to every living cell in the body. To use that food and release the energy stored in the food, the cells
need a gas called oxygen. The cells can only burn the food and release the energy when oxygen is present. This process is called respiration and is essential to almost every form of plant and animal life on earth.

Most animals that live in the water get the oxygen they need with the help of gills. You can see the gills on the side of a fish’s head. These feather-like gills are capable of absorbing oxygen that is dissolved in the water and releasing it into the fish’s blood.

Insects take in oxygen through small holes on the sides of their abdomens called spiracles. You can see these little holes in nice lines on both sides of this insect’s body. They lead to tubes that carry the oxygen to internal organs.

Mammals, which include humans, have very complex respiratory systems. They get their oxygen from the air that surrounds our planet. The air is made up of 78 percent nitrogen and 21 percent oxygen. The other 1 percent includes argon, carbon dioxide, water vapor, and some other gases in very small amounts. The air is breathed in and goes to lungs, which exchange the oxygen for a waste product called carbon dioxide. Some mammals that live in the water, such as dolphins and whales, breathe through blowholes on the tops of their heads. They must surface regularly to take in new supplies of air and to release the waste products of respiration.

**HUMAN RESPIRATORY SYSTEM**

Let’s look closely at the human respiratory system. Air typically enters the body through the nostrils of the nose. Small hairs just inside the nostrils may stop some of the unwanted dust and dirt particles found in the air. The air moves from the nostrils into the two nasal cavities of the nose. A wall of cartilage and bone separates the two cavities. The air is heated at this point by warm blood flowing through blood
vessels in the nasal cavities. This acts like a radiator. Air taken in through the nose is warmed before going to the lungs. Air can also be brought into the body through the mouth, but here there are fewer opportunities for dust and dirt particles to be removed, and there will not be this warming process. Try this experiment to see the difference in air temperature as it enters the body. Breathe with your mouth closed and through your nose. Then purposely breathe with your mouth as if your nose was stuffed up. The air that you breathe in through the mouth will feel cooler at the back of your throat.

The nose produces a continuous supply of mucus. This mucus, which is replaced every 20 minutes, has two main jobs. One is to add some moisture to the air so that the internal tissues of the respiratory system don’t dry out. The other job is to catch unwanted particles and bacteria from the air. The unwanted particles are caught in the mucus and then billions of small hairlike structures called cilia move the mucus into the esophagus that leads to the stomach. The stomach releases digestive juices that contain hydrochloric acid. This acid destroys the foreign material. Sometimes the particles caught in the mucus of the nasal cavities irritate the nose and causes sneezing. This is another way to release unwanted particles from the body.

You can see it is best to breath through the nose because of the warming, filtering, and moistening of the air. From the nose, the air travels into the throat. At one point, the throat leads to two separate paths. One is the esophagus, which is the tube leading to the stomach. The other is the trachea, a tube leading to the lungs. At the top of the trachea is a small flap called the epiglottis. This flap covers the opening to the trachea so that food won’t go into the trachea when you swallow. When we breathe, the flap opens to allow the air to enter the trachea and the rest of the respiratory system.
LARYNX
At the top of the trachea is the larynx, which contains the vocal cords. Two small folds of tissue are stretched across the larynx with a small gap between them. When we talk, the muscles of the larynx tighten the tissue, making the opening smaller. As air from the lungs goes past the opening, the vocal cords vibrate, making sounds. The pitch of a sound is determined by the size of the larynx and the length of the vocal cords. Because men have larger larynxes and longer vocal cords, their voices are usually lower than women’s. The shorter vocal cords of a female vibrate faster so the sound has a higher pitch.

You can feel your trachea and find the location of your larynx. With a finger, rub gently on the front of your neck and you will feel a tubelike structure with bumps. This is your trachea or windpipe. What you feel as bumps are actually bands of cartilage that support the trachea. The larynx is made of a piece of cartilage that is larger than the other cartilage in the trachea. On a male, you can easily see this cartilage sticking out. It is referred to as the “Adam’s apple.” Some people think that only males have Adam’s apples, but actually everyone has an Adam’s apple. Only the larynx on a male is larger than a female’s, so the Adam’s apple shows up clearly on males but is not very noticeable on females.

TRACHEA AND ALVEOLI
When air enters the trachea, there is another round of mucus found in the lining of this passageway. If dust particles have made it this far, they may be caught in this mucus before moving into the sensitive and delicate lungs. Dust that is trapped by this mucus can be sent back up to the mouth or nose by the movement of small cilia, or a person may cough to remove the mucus and foreign matter.
The trachea branches into two paths before entering the lungs. These branches are called the left and right bronchi. Inside the lungs, the bronchi divide into smaller and smaller branches. At the end of the smallest branches are clusters of hundreds of round sacs called alveoli. They resemble grapes on a vine. The body has about 600 million alveoli. It is here that the exchange of gases takes place. Each alveolus has tiny blood vessels called capillaries running around it. When the oxygen-rich air enters the lungs and travels to the millions of alveoli, the oxygen passes through the cell walls of the alveoli into the capillaries of the circulation system. The blood picks up the oxygen and releases to the alveoli carbon dioxide, the waste product carried from the body's living cells.

Blood which contains carbon dioxide from the cells of the body will appear blue, while blood rich with fresh oxygen will be red. This exchange must happen quickly, so that is why there are so many of these little exchange sacs. They allow for a greater area for exposure to capillaries. If the material that makes up all the alveoli in your two lungs were spread out flat, it would cover an area the size of a tennis court!

BREATHING
A newborn baby takes about 40 breaths each minute. A one-year-old child takes about 24 breaths per minute. An adult takes about 14 breaths per minute. However, during exercise, the rate can increase to over 100 breaths per minute. Adults breathe in about seven to ten liters of air each minute.

It is our brains that control the breathing process. We don’t have to think about breathing, it is automatic. The control center for breathing is found in the brain stem. It uses information from various parts of the body concerning the levels of carbon dioxide and oxygen in the blood. Based
on the comparison of carbon dioxide and oxygen levels, the brain sends electrical signals to the diaphragm and chest muscles, which cause us to breathe in and out.

To bring air into our bodies, the diaphragm, which is a bell-shaped sheet of muscle, contracts. This causes it to flatten, creating a larger area in the chest cavity and, as a result, a space of low air pressure. Air rushes in through the nose and trachea to fill the lungs and expand them to fill up some of this low-pressure area. When the diaphragm relaxes, it moves back into its normal bell-shaped position, which causes the chest cavity to shrink and push air out of the lungs. The lungs actually are responding to the change in pressure around them.

The diaphragm and muscles of the rib cage are what cause breathing to take place. Here is a simple demonstration of how the diaphragm does its job. We will cut the bottom off this 2-liter plastic bottle. A mouth of a balloon is cut away. This balloon is then stretched over the bottom of the bottle and secured with a rubber band. A second balloon is slipped through the mouth of the bottle and held in place. Now when the balloon, which represents the diaphragm, is pulled down, notice what happens to the other balloon, which represents a lung. When the diaphragm balloon is moved back to its normal position, notice that the lung releases air, just like a lung exhaling.

Thank goodness that the act of breathing is an automatic operation and requires no thought. If you hold your breath, after a short period of time, you automatically start gasping for breath. Your body needs a constant supply of oxygen. You are breathing while awake and while asleep. During sleeping, the breathing rate slows down because there is not as much of a demand for oxygen. Muscles are at rest and there is less carbon dioxide being produced than during a period of high activity. Breathing during sleep is slower and more relaxed.
RESPIRATORY SYSTEM
The respiratory system works with the circulatory system to transport oxygen to the cells and to return carbon dioxide to the lungs for elimination from the body. The heart sends blood that has returned through veins from all over the body into the lungs. This blood is carrying carbon dioxide which it will release into the alveoli. Then oxygen from recently inhaled air will pass through the cell walls of the alveoli and capillaries into the blood. The blood will continue back to the heart, where it receives its push to travel to various parts of the body. As the blood moves into capillaries, it passes by individual living cells, where the gas exchange occurs. Oxygen goes into the cell and carbon dioxide goes into the blood. This exchange takes place in the alveoli and body cells because gases tend to move from areas of concentration into areas of less concentration. What this means is that because the blood entering the lung is carrying carbon dioxide and there are lower amounts of that gas in the alveoli, the gas moves through the capillary and alveoli cell walls and into the area of lower concentration. The same thing happens to the oxygen in the alveoli as it moves into the bloodstream. This also accounts for the passage of gases from the capillaries into the cells and from the cells into the capillaries.

The respiratory system is very important to our survival. Being deprived of oxygen for just a few minutes can mean great damage to the body. After a few minutes of lack of oxygen, the brain begins to suffer. If a lack of oxygen persists, death can soon follow. We can survive for days without food or water, but if deprived of oxygen, we can only survive for a few minutes.

A HEALTHY RESPIRATORY SYSTEM
You want to maintain a healthy respiratory system. Exercise regularly and avoid situations that are health risks. Exercise helps to build up the diaphragm muscle and to keep it strong.
As you are probably aware, the leading preventable cause of lung cancer is the use of smoking tobacco. Smoking causes many problems for the human body. One of the most obvious is the damage chemicals inside cigarettes do to the lungs and the respiratory system. Nicotine in cigarettes is a chemical that is addictive and causes the body to crave it. This makes it very difficult for people to stop smoking. Their bodies have become used to the nicotine and are addicted to that chemical.

Another substance released into the body while smoking is carbon monoxide. This is a dangerous gas because it takes the place of oxygen in the blood. In fact, the hemoglobin in the blood that carries the oxygen throughout the circulatory system is more attracted to carbon monoxide than to oxygen. This means less oxygen is transported to the cells and tissues of the body, which can lead to harmful effects.

Tar is another damaging substance found in cigarette smoke. The tar enters the lungs in a vapor form but then liquefies inside the lungs, where it can clog passageways and kill cilia. You may have seen roofers using tar on roof tops for buildings and offices.

Each day the number of people who die from lung cancer due to smoking in the United States is equal to the total number of passengers on two 747 superjets. That is almost 1,000 people. Every year, over 400,000 people in the United States die from the effects of smoking. People who smoke are twice as likely to die from heart disease as non-smokers. They are ten times more likely to develop cancer of the throat and mouth. They are twenty-five times more likely to develop lung cancer that leads to death. Smokers have a greater chance of developing colds, coughs, and other respiratory problems.
The good news is that it is possible to stop smoking and almost a million people successfully stop each year. The other good news is that if a person stops, his or her body will begin a healing process that can improve the health of their lungs over a period of years.

The best idea is not to smoke at all. In fact, it would be a good idea to avoid any situations in which the quality of the air that is inhaled into your living body is questionable. Stay away from polluted air with the same intentions that would stop you from swimming in polluted water. After all, it is the health of your body and the trillions of living cells that help it to function properly that we’re talking about here.

VIDEO QUIZ
Students may write the answers to the following questions on a separate piece of paper or on the duplicating master entitled Video Quiz.

Question 1: The process that enables cells of the body to burn food and release energy is called
a. circulation   b. digestion   c. respiration
   d. excretion

Question 2: The throat leads to two separate paths. One path goes to the stomach. This path is called the
a. trachea   b. esophagus   c. epiglottis   d. mucus

Question 3: The other path from the throat leads to the lungs. It is called the
a. trachea   b. esophagus   c. epiglottis   d. mucus

Question 4: This flap covers up the path leading to the lungs so that during eating food doesn’t “go down the wrong tube.”
   a. trachea   b. esophagus   c. epiglottis   d. mucus
Question 5: The exchange of gases inside the lungs actually occurs inside tiny sacs called
a. bronchi  b. cilia  c. capillaries  d. alveoli

Question 6: The brain sends electrical messages to the chest muscles and the __________ for breathing in and out to occur.
  a. diaphragm  b. bronchi  c. cilia  d. alveoli

Question 7: The chemical in cigarettes that causes addiction is called
  a. tar  b. nicotine  c. carbon monoxide

Question 8: The gas that is most abundant in the earth’s atmosphere is
  a. oxygen  b. carbon dioxide  c. sulfur  d. nitrogen

Question 9: Insects have little holes along their abdomens to take in oxygen. These holes are called
  a. gills  b. lungs  c. bronchi  d. spiracles

Question 10: The nose produces a continuous supply of __________ to put moisture in the air and catch dust and bacteria.
  a. mucus  b. bronchi  c. cilia  d. oxygen
THE RESPIRATORY SYSTEM

Video Quiz

Directions: At the conclusion of the videotape there will be a short quiz with these questions. Write your answers in the space provided. Use the back of this sheet if necessary.

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THE RESPIRATORY SYSTEM

Vocabulary

Directions: Write a definition for each of the terms listed below:

1. respiration-
2. gills-
3. spiracles-
4. carbon dioxide-
5. mucus-
6. cilia-
7. esophagus-
8. trachea-
9. epiglottis-
10. larynx-
11. bronchi-
12. alveoli-
13. diaphragm-
Parts of the Respiratory System

Directions: Label the diagram with the terms from the box at the bottom of the page.

Larynx  Epiglottis  Trachea  Nose
Diaphragm  Right Bronchus  Left Bronchus  Nasal Cavity
We are able to breathe in and out because of differences in air pressure. The pictures below illustrate inhaling and exhaling. Describe what is happening next to each illustration.

**Exhaling**

**Inhaling**
Lung Capacity

PURPOSE: To determine lung capacity by measuring the amount of exhaled air.

MATERIALS: a large jug such as a water bottle from a water cooler
- a graduated cylinder (1,000 ml)
- a grease pencil
- water
- tubing
- soda straws
- large pan for the jug to sit in upside down

PROCEDURES:
1. Use the graduated cylinder to measure out 1,000 ml of water and pour it into the large jug. Use the grease pencil to mark the water level and mark it 1,000.
2. Pour 500 ml more water into the jug and mark that line. Label it 1,500 ml.
3. Continue to add water to the jug and mark off the water level at each 500 ml.
4. Fill the pan with water.
5. Fill the jug with water. Hold your hand over the mouth of the jug and invert it so that its mouth is down in the pan.
6. Tilt the jug slightly so that one end of the tubing can fit into the mouth of the jug. Put a straw in the other end of the tube to be used as a mouthpiece.
7. Record the level of the water in the jug. Take a normal breath. Place your mouth on the straw and hold your nose. Exhale normally into the straw.
8. Record how far down the water level goes. The difference between the original number and the new one is the amount of lung capacity in a normal breath.
9. Repeat these steps but this time take the largest breath you can. This will be the full capacity of your lungs.

OBSERVATIONS:

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<th>TRIAL</th>
<th>STARTING WATER LEVEL</th>
<th>END WATER LEVEL</th>
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<tr>
<td>FULL</td>
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CONCLUSIONS: What is your full lung capacity? ____________________

What is the difference between your two trials? ____________________
Quiz

Directions: Use the space provided to answer the following questions. Use the back of this sheet if necessary.

1. What is the job of the respiratory system?

2. What is respiration?

3. Describe the path of air as it is inhaled into the human respiratory system.

4. How does the diaphragm help during inhaling and exhaling?

5. The mucus in the nostrils perform two main jobs. What are those jobs?

6. Why do we occasionally sneeze?

7. What job does the epiglottis perform?

8. What happens in the alveoli in the process of gas exchange?

9. What are some of the substances released in cigarette smoke that are harmful to the respiratory system?