



Heart and Lungs

from *The Science of Air Teacher's Guide* and for *Mr. Slaptail's Secret*

Written by

Nancy P. Moreno, Ph.D.

Barbara Z. Tharp, M.S.

Judith H. Dresden, M.S.

BioEdSM

Teacher Resources from the
Center for Educational Outreach at
Baylor College of Medicine

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Third edition. First edition published 1997.
Printed in the United States of America

ISBN: 978-1-888997-74-3

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The activities described in this book are intended for school-age children under direct supervision of adults. The authors and Baylor College of Medicine cannot be responsible for any accidents or injuries that may result from conduct of the activities, from not specifically following directions, or from ignoring cautions contained in the text.

Development of this unit was supported, in part, by grant numbers R25 ES06932 and R25 ES010698 from the National Institute of Environmental Health Sciences (NIEHS) of the National Institutes of Health (NIH). The opinions, findings and conclusions expressed in this publication are solely those of the authors and do not necessarily reflect the official views of Baylor College of Medicine, NIEHS or NIH.

Authors: Nancy P. Moreno, Ph.D., Barbara Z. Tharp, M.S., and Judith H. Dresden, M.S.
Editor: James P. Denk, M.A.
Designer and Illustrator: Martha S. Young, B.F.A.

ACKNOWLEDGMENTS

The Science of Air educational materials, first developed as part of the My Health My World® project at Baylor College of Medicine, have benefited from the vision and expertise of scientists and educators representing a wide range of specialties. Our heartfelt appreciation goes to Michael Lieberman, M.D., Ph.D., William A. Thomson, Ph.D., and Carlos Vallbona, M.D., who have lent their support and expertise to the project.

Special acknowledgment is due to our original partners in this project, the Texas Medical Association and the American Physiological Society (APS). We especially thank Marsha Lakes Matyas, Ph.D., of APS, for her direction of field test activities and ongoing collaboration.

Several colleagues provided valuable assistance during the development of this guide. In particular, we would like to thank Zenaïdo Camacho, Ph.D., Cynthia Jumper, M.D., Fabiola Pineda, M.S., Ronald Sass, Ph.D., and Cathey Whitener, M.S.

Special thanks go to the National Institute of Environmental Health Sciences, Allen Dearry, Ph.D., Frederick Tyson, Ph.D., and Liam O’Fallon for their support of the My Health My World project and the related Environment as a Context for Opportunities in Schools (ECOS) project.

We are especially grateful to the many classroom teachers in Washington, D.C., and Houston and Austin, Texas, who participated in the field tests of these materials and provided invaluable feedback.



Center for Educational Outreach
Baylor College of Medicine
One Baylor Plaza, BCM411
Houston, Texas 77030
713-798-8200 | 800-798-8244 | edoutreach@bcm.edu
www.bcm.edu/edoutreach | www.bioedonline.org | www.k8science.org

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Breathing

Life Science Basics



The cells in our bodies require oxygen to complete the reactions that allow energy to be released from food. The process through which these reactions occur, known as aerobic (from *aeros* for air) respiration, produces carbon dioxide as a waste product.

Many large organisms have developed systems to supply cells with oxygen and eliminate carbon dioxide from the body. Fish gills, for example, draw water across thin membranes, thus allowing dissolved oxygen to be transferred into the bloodstream. Insects have a network of small tubes that branch throughout the body and carry air directly to individual cells. Most other land animals use lungs and a blood transport (circulatory) system to take in oxygen and transport it throughout the body, while simultaneously removing carbon dioxide.

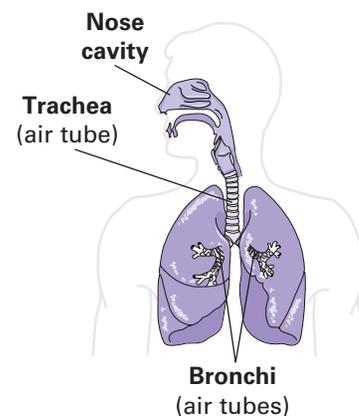
The human respiratory system is similar to that of all other mammals. Air enters the nose, where it is warmed and filtered. It passes through the pharynx at the back of the throat and enters the larynx (also called the Adam's apple), or voice box. From there, it passes through the trachea into the chest cavity. The trachea branches into two tubes (plural, bronchi; singular, bronchus), each leading to one of the lungs. Each bronchus branches and rebranches, forming smaller and smaller ducts.

These terminate in tiny pockets, called alveoli, which are surrounded by minute blood vessels. Within the alveoli, oxygen moves into the blood stream and carbon dioxide diffuses out.

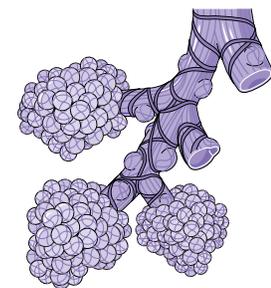
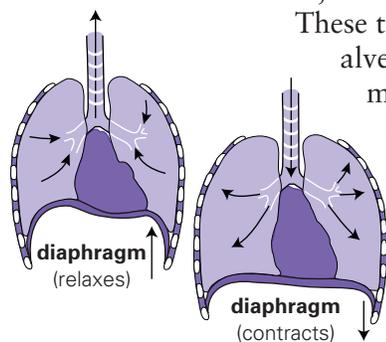
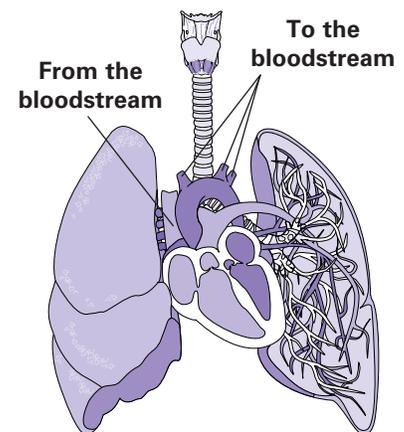
Breathing, the actual process of drawing in and expelling air, is a partially passive process controlled by changes

in the volume of the chest cavity. The work of breathing is accomplished by muscles in the walls of the chest and in the diaphragm, a thin layer of muscle at the base of the chest cavity. When these muscles tighten, they increase the size of the space inside the chest. This causes air to rush into the lungs. When the muscles relax, the space becomes smaller and air moves out of the lungs.

When we breathe, all components of air (including pollutants) are drawn into the lungs. Some harmful substances can be expelled from the body by coughing or sneezing. Others are trapped and eliminated in mucus. A few, however, remain in the lungs, where they can cause permanent irritation or damage. Some chemicals in air even are absorbed into the bloodstream through the lungs and are transported to other parts of the body.



Air enters the body through the nose and mouth. When it reaches the lungs, some oxygen is taken into the bloodstream, and carbon dioxide, a waste product, is released.



If you spread out all the tiny pockets in the lungs, they would cover an area the size of a tennis court.

Heart and Lungs

Life Science



The heart and lungs work together to supply all the tissues in the body with oxygen and other materials, and to carry away waste products, such as carbon dioxide. All the cells in our bodies need oxygen to carry out the reactions that release energy. Carbon dioxide, a waste product of this process, is manufactured inside cells when energy is released from sugars and other molecules.

Usually, when parts of the body require more oxygen (as during exercise), the lungs and heart respond by working faster. The lungs also take in more air, so that more oxygen can be absorbed into the blood stream and transported to hard-working tissues.

We often measure heart rate by feeling the surge of blood after each heart beat at places on the body where arteries are near the surface of the skin (the wrist, for example). This recur-

rent surge is known as the pulse. The number of pulses per minute usually is referred to as pulse rate (heart beats per minute). The average pulse rate for a child ranges from 60 and 120 beats per minute.

SAFETY

Do not have students measure the pulse in their necks. Too much pressure on the carotid artery can stimulate a reflex mechanism that slows down the heart. Instead, have students use their wrists (see “Radial Pulse Point,” p. 3, left sidebar).

Be aware of risks to students with respiratory illnesses, such as asthma. Make sure students understand that all activities are to be carried out in an orderly fashion. Always follow district and school laboratory safety procedures.

SETUP

This investigation works best when the class is divided into two-person teams. The members of each team should take turns monitoring each other. Conduct this activity with the entire class if your students are not able to tell time.

Cut the blue and red construction paper (9 in. x 12 in.) in half horizontally to make 9 in. x 6 in. sheets.

PROCEDURE

Part 1. Making the cut-outs

1. Give each student one sheet each of blue and red construction paper. Direct students to cut out a set of lungs and a heart from each sheet, using the templates on the “Heart and Lungs

CONCEPTS

- The functions of the heart and lungs are linked.
- The heart and circulatory system work with the lungs to supply the body with oxygen and to eliminate carbon dioxide.
- The rates at which the heart and lungs work depend on levels of activity.

OVERVIEW

Students will investigate their breathing and pulse rates, and learn how these measurements are affected by physical activity.

SCIENCE, HEALTH & MATH SKILLS

- Observing
- Measuring
- Comparing data
- Drawing conclusions

TIME

Preparation: 10 minutes

Class: 30–45 minutes to make cut-outs and measurements; 30 minutes to graph and summarize results

MATERIALS

Teacher (see Setup)

- 12 sheets of red construction paper
- 12 sheets of blue construction paper
- Paper cutter

Each group will need:

- Stopwatch with a second hand, wristwatches or classroom clock

Each student will need:

- Pair of scissors
- One sheet of each color of prepared construction paper
- Copy of student sheets



Unit Links

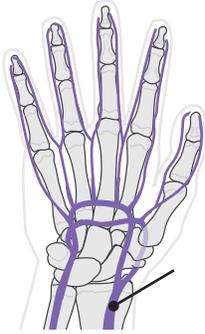
Mr. Slaptail's Secret
Science box, p. 17

Explorations
Where Does the Air Go? p. 8

Continued



RADIAL PULSE POINT



The safest and most common site to check pulse is on the thumb-side of the wrist (radial pulse).^{*} Use the middle finger and ring finger together to apply slight pressure at the location shown above.

* Pulse site recommended for the general public by the National Heart, Lung, and Blood Institute, National Institutes of Health.

Cut-Outs” student sheet. (This can be integrated into a mathematics or art lesson as a symmetry activity.) Students should write their names on their cut-outs.

Part 2. Gathering data

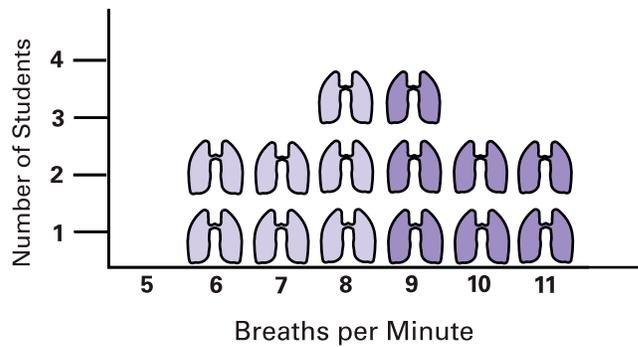
1. Explain to students that they will be investigating their breathing and heart rates. Make sure they understand that a “rate” is a measure of “how fast” or “how slow” something is happening.
2. Group the students into pairs. Ask them to sit quietly and breathe normally. Have one student count the number of times his/her partner inhales (breathes in) in one minute, and record the results on the “Heart and Lungs Data Sheet.” Older students can time themselves, using a wristwatch or stopwatch. If a student has difficulty observing the breathing of his/her partner, instruct the student being observed to dangle a strip of tissue in front of his/her nose. Have students repeat the measurements at least three times to calculate an average. Then instruct the students to switch jobs.

With younger students, conduct this procedure as a whole class activity. You can either time them or direct the timing, while students take turns counting and recording their partners’ breathing rates.

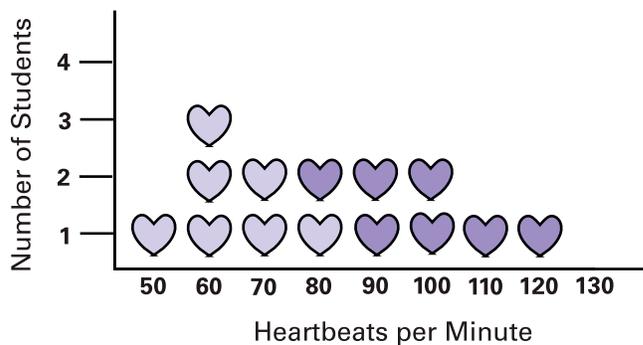
3. Prepare the students to measure their pulse rates (heart beats per minute) by demonstrating the safest way to locate a pulse point (see “Radial Pulse Point,” left sidebar). Give students time to locate their pulse points and practice counting beats.
4. Have students measure their heartbeats by counting the number of times they feel a tiny surge at their pulse points, while their partners time them for 15 seconds. Older students should enter this value on their worksheets and multiply by four to obtain the number of beats per minute. They should take three readings. Younger students may add this value four times to find beats per minute. Have the students switch jobs and repeat the process. Again, with younger students, you probably will want to direct the activity and measure the time.
5. Next, tell the students that they are going to investigate their breathing and pulse (or heart) rates after physical activity. Ask, *What do you think will happen to your heart rate when you exercise? What about your breathing rate?* Have one member of each team run in place for one minute and sit down. Have their partners determine their breathing rates again. Older students should repeat this procedure three times. Then, let the students switch jobs and repeat the process. This step should be teacher-directed for younger students.
6. To investigate pulse rate after activity, have the students repeat the process described in steps 3 and 4 after running in place for one minute.



Class Graph of Breaths per Minute



Class Graph of Heartbeats per Minute



QUESTIONS FOR STUDENTS TO THINK ABOUT

- Do you think that trained athletes have higher or lower breathing and pulse rates than students at rest? During activity? How could this be investigated?
- How do your “rates” compare to those of your parents?
- How might activities like smoking affect heart and breathing rates during exercise?
- What do you think might have happened to Mr. Slaptail’s breathing and pulse rates after he stopped smoking?

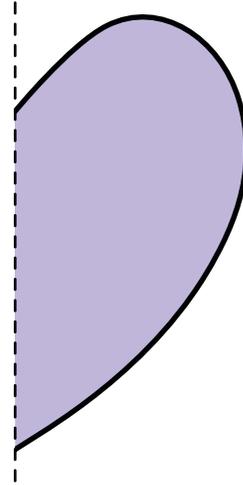
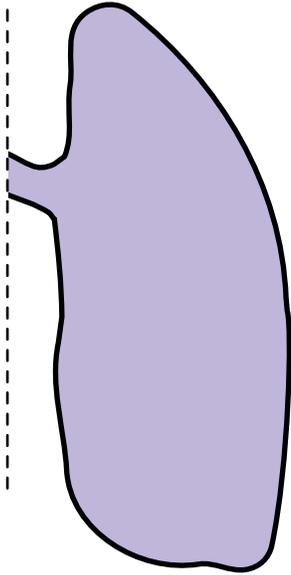
Part 3. Graphing

1. Draw two large grids for class graphs on chart paper or on the board. Label one grid “Heartbeats Per Minute” and the other “Breaths Per Minute.” Lines on the vertical axis should be 6 cm apart. Lines on the horizontal axis should be approximately 12 cm apart. Make sure students understand that they were able to quantify their heart rates by counting the tiny surges of blood moving through an artery.
2. Using blue for resting rate and red for active rate, have students write their names and rates on the appropriate cut-outs. Tape students’ cut-outs on the appropriate class graphs OR help each student position his or her cut-outs on the graphs.
3. Ask, *Where are most of the blue hearts on the graph? How about the red hearts? Where are the blue lungs? The red lungs? How does exercise affect a person’s breathing rate? Heart rate?* Help students notice that heart and breathing rates change together.

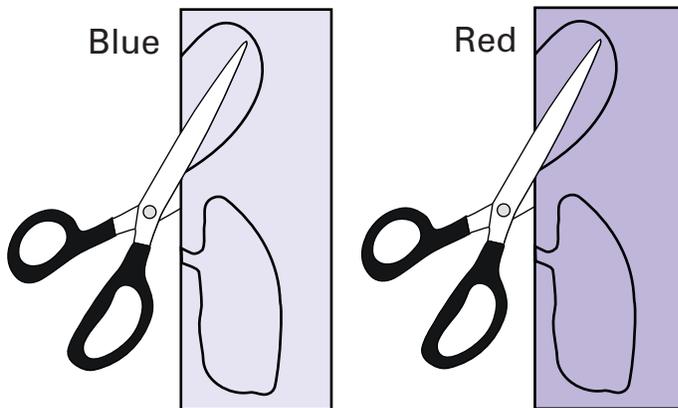
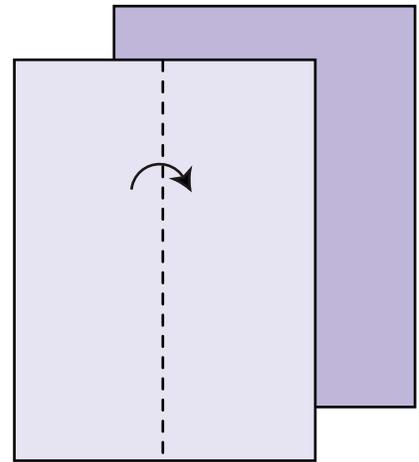


Heart and Lungs Cut-Outs

1. Cut out the two shapes below.



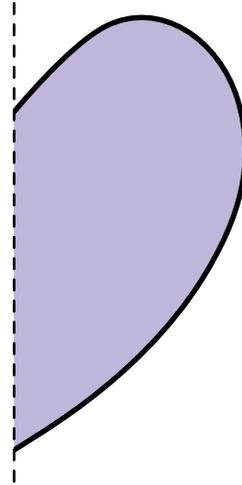
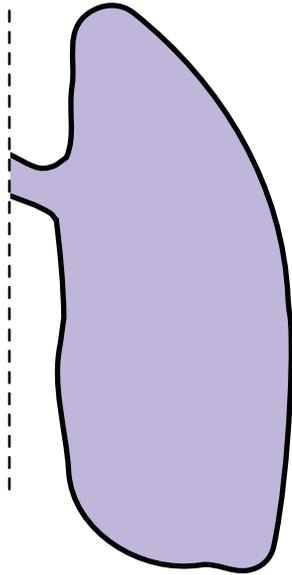
2. Fold your red and blue sheets of paper in half the long way.
3. Trace around the shapes on your blue paper. Cut along the lines and open your heart and lung figures.
4. Lay the shapes on your red sheet. Trace and cut out the figures in the same way.



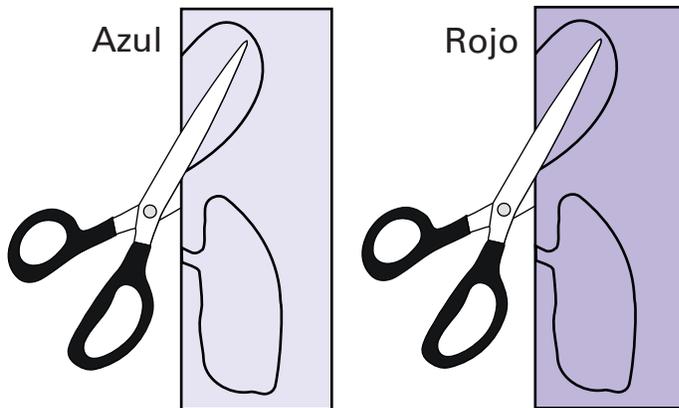
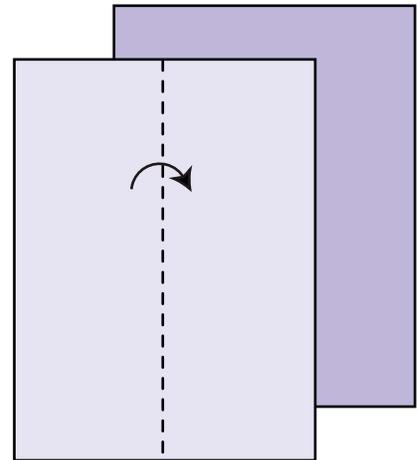
Figuras de Corazón Pulmones



1. Recorta las dos figuras que están abajo.



2. Dobra tus papeles (uno rojo y uno azul) a lo largo.
3. Pon las figuras encima del papel azul y traza alrededor de cada una. Recórtalas y abre tus figuras de corazón y pulmones.
4. Ahora, pon las figuras encima del papel rojo y recórtalas también.





Heart and Lungs Data Sheet

Name _____

Breathing

1. Have a partner count how many times you breathe out during one minute. Try this three times and write the numbers in the boxes to the right. Add these three numbers and write your answer in the box at the bottom.

+

2. Divide this number by 3 to find your average breathing rate (number of breaths per minute).

$$\underline{\hspace{2cm}} \div 3 = \underline{\hspace{2cm}}$$

Average Breathing Rate

Pulse

1. Now, have a partner count your pulse beats for 15 seconds. Multiply this number by 4. Try this three times and write the numbers in the boxes to the right. Add all three numbers and write your answer in the box at the bottom.

	× 4 =	
	× 4 =	
	× 4 =	

+

2. Divide this number by 3 to find your average pulse rate (number of heartbeats per minute).

$$\underline{\hspace{2cm}} \div 3 = \underline{\hspace{2cm}}$$

Average Pulse Rate

Circle One:

These are my **RESTING** • **ACTIVE** rates.

Hoja de Datos-Corazon y Pulmones



Mi Nombre _____

Respiración

1. Pide a tu compañero que cuente las veces que respire en un minuto. Hazlo tres veces y escribe los valores aquí.

+

2. Divide este numero por tres para obtener un promedio de tu tasa de respiración (veces por minuto).

$$\underline{\hspace{2cm}} \div 3 = \underline{\hspace{2cm}}$$

Tasa de Respiración Promedia

Pulso

1. Ahora, pide a tu compañero que mida 15 segundos mientras te tomas el pulso. Hazlo tres veces y escribe los valores aquí

 × 4 = × 4 = × 4 =

+

2. Divide este numero por 3 para obtener un promedio de tu tasa cardiaca (latidos por minuto)

$$\underline{\hspace{2cm}} \div 3 = \underline{\hspace{2cm}}$$

Tasa Cardiaca Promedia

Marca Uno:

Estos son mis resultados cuando estoy **DESCANSANDO • ACTIVO.**