



The rate at which the heart and lungs work depend on levels of activity. Photo © Denys Kuvalev. Licensed for use.

Heart and Lungs

The Science of Air: Activity 7

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Heart and Lungs

This activity's objectives are aligned with the National Science Education Standards, specifically those related to Science as Inquiry and Physical Science. Heart and Lungs uses guided inquiry to illustrate that breathing and heart rates both change based on a person's level of activity (resting versus exercising).

Students will measure breathing and heart rates at rest and following exercise. They will discover that breathing and heart rates increase at higher levels of activity (i.e., after exercising). During this activity, students will make predictions, take measurements, graph, compare data, and draw conclusions based on their investigation.

Concepts

- The functions of the heart and lungs (cardiovascular and respiratory systems) are linked.
- The heart and circulatory system work with the lungs to supply oxygen to the body and eliminate carbon dioxide.
- The rates at which the heart and lungs work depend on a person's level of activity, and their individual fitness levels.

Reference

Moreno N., B. Tharp, and J. Dresden. (2011). *The Science of Air Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-74-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

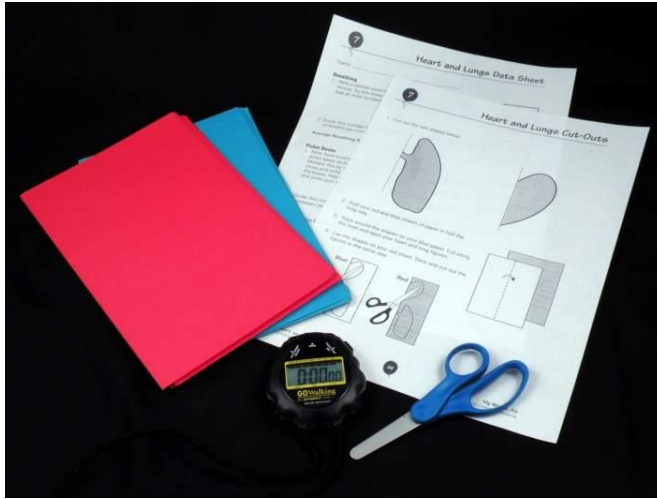
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Key Words

lesson, teaching slides, lesson demonstration, life science, biology, air, lung, lungs, breath, breathing, pulmonary, heart, heart rate, blood pressure, cardiovascular system, respiratory system,

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Materials



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Materials

This activity works best with the class divided into 2-person teams, with team members taking turns monitoring each other. Conduct this activity with the entire class if you teach young students who are not yet able to tell time.

Materials per Student Group

- Stopwatch with a second hand, wrist watches, or classroom clock

Materials per Student

- Pair of scissors
- 1/2 sheet of blue, 9-in. x 12-in. construction paper. (see Setup)
- 1/2 sheet of red, 9-in. x 12-in. construction paper.
- Copy of the student sheet, "Heart and Lungs Cut-Outs"
- 2 copies of "Heart and Lungs Data Sheet" (one for resting heart and breathing rate, and one for heart and breathing rate after exercise)
- Chart paper

Setup

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

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Science Safety Considerations

- Follow all instructions.
- Begin investigation only when instructed.
- Be careful cutting objects with scissors.
- Report accidents or spills.
- Wash hands thoroughly after the investigation.



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Science Safety Considerations

Safety first! Students always must think about safety when conducting science investigations. This slide may be used to review safety with your class prior to beginning the activity.

Also, keep the following points in mind.

- Always follow your district school safety guidelines.
- Have a clear understanding of the investigation in advance. Practice any investigation with which you are not familiar prior to class.
- Make sure appropriate safety equipment, such as safety goggles, is available.
- Continually monitor the area where the investigation is being conducted.

References

1. Dean, R., M. Dean, and L. Motz. (2003). *Safety in the Elementary Science Classroom*. Arlington, VA: National Science Teachers Association.
2. Moreno N., B. Tharp, and J. Dresden. (2011). *The Science of Air Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-74-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

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How Fast Does Your Heart Beat?

- Have you ever wondered how fast your heart beats when you run?
- Does your heart beat faster when you run or when you rest?
- How do your heart and lungs work together?



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How Fast Does Your Heart Beat?

To focus student's attention, begin the activity by asking, "Have you ever wondered how fast your heart beats when you run?" and "Does your heart beat faster when you run or when you rest?" Stimulate a discussion about collaboration between the heart and lungs by asking, "Do your heart and lungs work together?" Mention that students will perform an experiment to answer these questions.

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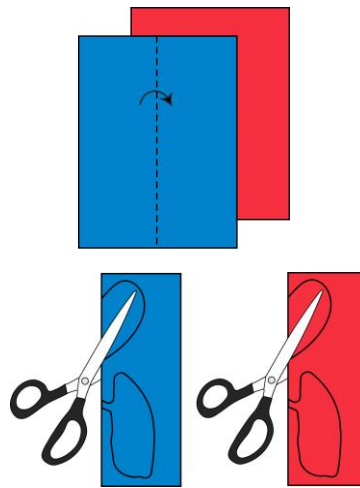
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Let's Get Started

1. Collect materials.
2. Cut out the patterns on the "Heart and Lungs Cut-Outs" worksheet.
3. Fold the red and blue paper in half long way. Trace the patterns on the paper.
4. Cut on the traced lines.



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Let's Get Started: Making the Cut-outs

In this activity, students will measure their breathing and pulse rates. They will discover that physical activity causes these rates to increase. Students will make predictions, take measurements, graph, compare data, and draw conclusions based on their investigation.

1. Have the Materials Manager from each group collect the materials.
2. Direct students to cut out the pattern for the lungs and for the heart from their worksheet. **Then**, have students fold the 9-in. x 6-in. sheets of red and blue paper in half (long way) and trace the heart and lung patterns onto the construction paper. Have students cut along the traced lines.
3. Each student will need 1 heart and 1 set of lungs in each color.

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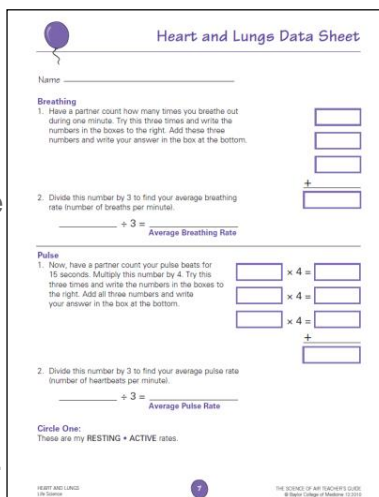
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Let's Continue: Breathing Rate

1. Sit quietly and breathe normally while your partner counts the number of times you breathe out in 1 minute.
2. Repeat the process two more times and record the results on your data sheet.
3. Follow the instructions to complete the "Breathing" section.
4. Switch jobs with your partner.



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).

_____ ÷ 3 = _____

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).

_____ ÷ 3 = _____

Average Pulse Rate

Circle One:
These are my **RESTING** • **ACTIVE** rates.

HEART AND LUNGS
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Let's Continue: Breathing Rate

Group students into pairs. Explain that they will be working as partners to investigate their breathing and heart rates. Make sure they understand that a "rate" is a measure of "how fast" or "how slow" something is happening.

Ask students to sit quietly and breathe normally. Have one student in each pair count the number of times his/her partner inhales (breathes in) in 1 minute, and then record the results on a copy of the "Heart and Lungs Data Sheet." Older students can time themselves, using a watch or stopwatch. (If a student has difficulty observing whether his or her partner is inhaling, dangle a strip of tissue in front of the test subject's nose.)

Have students repeat the measurements at least three times to calculate an average. Let the students switch jobs, so both measure and obtain their breathing rates. (With younger students, conduct this activity as a whole class activity. You can either time them or direct their timing, while students take turns counting and recording their partners' breathing rate.)

Ask students to record each trial on their worksheets and then calculate their average resting breathing rates.

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Let's Continue: Pulse Rate

1. Locate the radial pulse point on your partner's wrist. This is a point just below the palm on the thumb side.
2. Place two fingers on this point and feel for the rhythmic pulsing of his or her heart. You may have to adjust your finger position and pressure slightly to feel the pulse.
3. Count the number of pulses you feel for 15 seconds. Record the results in the "Pulse" section. Repeat two more times, then complete the rest of the instructions.
4. Switch jobs with your partner.



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Let's Continue: Pulse Rate

Prepare students to measure their pulse rates (heart beats per minute) by demonstrating how to locate a pulse points. The easiest and safest point to locate is on the top portion of the inner wrist.

Have students practice locating their pulse points and counting the number of times they can feel a small surge or "beat" in the artery. Instruct the students to count their heartbeats at their pulse points for 15 seconds.

Ask students how they could convert the number of beats measured in 15 seconds to a number per minute. (Older students should enter the number of beats counted on their worksheets and multiply by four to obtain the number of beats per minute. Younger students may add the value four times.) Older students should take the reading 3 times. Again, with younger students, you probably will want to direct the activity and measure the time.

Ask students record each trial on their worksheet and then calculate their average resting pulse rate.

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Let's Talk About It

- What happened to your heart rate when you exercised? What about your breathing rate?
- 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 might activities like smoking affect heart and breathing rates during exercise?



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Let's Talk About It

1. After discussing the questions above, tell the students that they are going to investigate their breathing and pulse (or heart) rates after physical activity.
2. 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.
3. 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.
4. Make sure students understand that they were able to quantify their heart rates by counting the tiny surges of blood moving through an artery.
5. 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.
6. 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.

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The Science of the Heart and Lungs

- 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.
- Usually, when parts of the body require more oxygen (as during exercise), the lungs and heart respond by working faster.
- 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).



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The Science of the Heart and Lungs

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.

During exercise, the lungs take in more air, so that more oxygen can be absorbed into the blood stream and transported to hard-working tissues.

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.

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