

Lab 7. Respiratory and Cardiovascular Systems: How Do Activity and Physical Factors Relate to Respiratory and Cardiovascular Fitness?

Introduction

All bodies, including humans, animals, plants, and bacteria, are made of cells. Some of these organisms (humans, animals, and plants) have their cells arranged into groups that all help the organisms to live. In humans and animals, scientists have identified several different body systems. Body systems are very organized groups of cells that serve specific functions that allow organisms to live. Although these systems are basically large groups of cells, those cells are organized into other levels. Pieces at each level work together to help pieces at the next level work. Body systems are made up of smaller units called organs, like the heart and lungs, which help the body take in and transport the nutrients it needs. Organs are made up of tissues, like muscle fibers in the heart, which help the organs function. For example, muscle tissue in the heart helps it to beat so it can transport materials through blood. Tissues are made up of cells, such as muscle cells that make up muscle fibers. Muscle cells shift proteins around to make muscle fibers grow and shrink so the whole muscle contracts, causing the heart to beat, which helps the rest of the systems work.

The human body is made up of several systems. The functions these systems perform include breaking down food we eat (digestive), directing the activities of the body (nervous), and helping us fight off disease (immune). The respiratory system (Figure L7.1) includes the lungs and trachea that breathe in air, containing oxygen (O_2) for use in the body, and breathe out waste gases, like carbon dioxide (CO_2). The cardiovascular system (Figure L7.2; also called the circulatory system) uses blood, arteries, veins, and the heart to deliver materials such as O_2 from your lungs. It also removes waste, like CO_2 , from cells; regulates body temperature; and helps the body fight off disease.

As you can see, the function of these two body systems is connected. They both work on moving gases into and out of the body. Cells in our body use O_2 to help make energy through a chemical process called cellular respiration. The same chemical process gives off CO_2 , which is transported through blood from cells to the lungs to be breathed out. The gas exchange function of these two body systems helps all the cells in the body. This is because most cells must use O_2 to create energy.

Cellular respiration uses O_2 to release energy from molecules in food we eat. A waste product from this process is CO_2 , the same gas that we breathe out. So as our body takes in and puts out these gases, so do the cells in our body. Indeed, that is why we breathe more when we exercise. We know that humans use respiration to produce energy because when a human breathes, the air that he or she inhales contains about 21% O_2 and less than 1% CO_2 ; however, when he or she exhales, the air contains about 15% O_2 and 5% CO_2 . Our cells need more O_2 to make more energy to support the increased physical activity.

The functions of these systems are connected to the amount of work the body does. So personal activity levels, like being an athlete or doing regular exercise, can influence how well these systems work. Also, the structure of these systems is influenced by physical factors such as height or frame size. Larger people may have more cells than smaller people, and having more cells means higher energy demands. Physical activity can also increase the number of cells in the body. Gender (boy or girl) can influence the function of different systems. Environmental factors can also affect the functions of the body; some locations

FIGURE L7.1 _____

Respiratory system

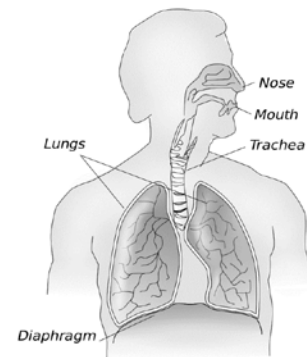


FIGURE L7.2 _____

Cardiovascular system



have higher or lower amounts of O₂ available in the air. With less O₂ in the air, the body has to breathe more to get the O₂ it needs for activity. The function of these body systems is tied to the energy needs of the body.

Your Task

Design an investigation to explore the relationship between fellow students' cardiovascular and respiratory fitness and different activity and physical factors.

The guiding question of this investigation is, **How do activity and physical factors relate to respiratory and cardiovascular fitness?**

Materials

You may use any of the following materials during your investigation:

- Elastic straps
- Transmitter belt
- Exercise heart rate monitor
- Timer
- Go!Link adaptor and laptop computer
- Stool (1–2 feet high)
- Cardiovascular fitness protocol
- Cardiovascular fitness table
- Lab 7 Reference Sheet
(1 per student)

Safety Precautions

Follow all normal lab safety rules. In addition, take the following safety precautions:

1. Notify your teacher if you have heart or other health conditions.
2. The heart rate monitor contains electrical connections covered by metal plates that are safe to touch your skin. However, only use the heart rate monitor equipment as directed. Any playing or non-approved use of the equipment could potentially hurt you or your classmates.

Investigation Proposal Required? Yes No

Getting Started

You will be given a Lab 7 Reference Sheet that includes a cardiovascular fitness protocol and a cardiovascular fitness table; these resources will guide the data collection process. After reviewing this sheet, you will need to determine what type of data you need to collect, how you will collect the data, and how you will analyze the data. To determine *what type of data you need to collect*, think about the following questions:

- What personal or physical factors could influence respiratory and cardiovascular fitness?
- What type of measurements or observations will you need to record during your investigation?

To determine *how you will collect your data*, think about the following questions:

- What types of treatment conditions will you need to set up and how will you do it?
- During the experiment, when will you collect data and how often will you collect it?
- How will you make sure that your data are of high quality (i.e., how will you reduce error)?
- How will you keep track of the data you collect and how will you organize it?

To determine *how you will analyze your data*, think about the following questions:

- How will you determine overall cardiovascular fitness?
- How will you compare subgroups?
- What type of calculations will you need to make?
- What type of graph could you create to help make sense of your data?

Connections to Crosscutting Concepts, the Nature of Science, and the Nature of Scientific Inquiry

As you work through your investigation, be sure to think about

- how scientists study systems by creating models of their structure and function,
- how the structure of living things affects the way they function,

- the way science is influenced by the society in which it takes place, and
- the specific role that experiments play in science.

Initial Argument

Once your group has finished collecting and analyzing your data, you will need to develop an initial argument. Your argument must include a claim, evidence to support your claim, and a justification of the evidence. The claim is your group's answer to the guiding question. The evidence is an analysis and interpretation of your data. Finally, the justification of the evidence is why your group thinks the evidence matters. The justification of the evidence is important because scientists can use different kinds of evidence to support their claims. Your group will create your initial argument on a whiteboard. Your whiteboard should include all the information shown in Figure L7.3.

FIGURE L7.3

Argument presentation on a whiteboard

The Guiding Question:	
Our Claim:	
Our Evidence:	Our Justification of the Evidence:

Argumentation Session

The argumentation session allows all of the groups to share their arguments. One member of each group will stay at the lab station to share that group's argument, while the other members of the group go to the other lab stations one at a time to listen to and critique the arguments developed by their classmates. This is similar to how scientists present their arguments to other scientists at conferences. If you are responsible for critiquing your classmates' arguments, your goal is to look for mistakes so these mistakes can be fixed and they can make their argument better. The argumentation session is also a good time to think about ways you can make your initial argument better. Scientists must share and critique arguments like this to develop new ideas.

To critique an argument, you might need more information than what is included on the whiteboard. You will therefore need to ask the presenter lots of questions. Here are some good questions to ask:

- What did your group do to collect the data? Why do you think that way is the best way to do it?
- What did your group do to analyze the data? Why did your group decide to analyze it that way?
- What other ways of analyzing and interpreting the data did your group talk about?
- What did your group do to make sure that these calculations are correct?
- Why did your group decide to present your evidence in that way?
- What other claims did your group discuss before you decided on that one? Why did your group abandon those other ideas?
- How sure are you that your group's claim is accurate? What could you do to be more certain?

Once the argumentation session is complete, you will have a chance to meet with your group and revise your original argument. Your group might need to gather more data or design a way to test one or more alternative claims as part of this process. Remember, your goal at this stage of the investigation is to develop the most valid or acceptable answer to the research question!

Report

Once you have completed your research, you will need to prepare an investigation report that consists of three sections that provide answers to the following questions:

1. What question were you trying to answer and why?
2. What did you do during your investigation and why did you conduct your investigation in this way?
3. What is your argument?

Your report should answer these questions in two pages or less. The report must be typed and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your claim is acceptable or valid!