

Activity 3.3.1: Gasping For Air

Introduction

Why can the human body last for only a few minutes without oxygen, yet can survive for days without food or water? Remember the *Rules of Three* that we discussed at the beginning of Unit 3. The body can last three minutes without air; yet it can last three days without water and three weeks without food! From these time limits it is easy to see that oxygen must be very important and that the body needs a near constant supply. What does oxygen provide to the body that is so important for survival?

Cells need energy to function. They obtain this energy from the energy storing molecule ATP. Think back to what you have already learned about ATP. It is formed by combining the nucleoside adenosine with three high energy phosphate groups. In order for ATP to be produced, oxygen must be available. Without oxygen, the addition of the third phosphate group does not occur, and ATP is consequently not produced. Without ATP, the body’s cells do not have a source of energy and will die once a cell’s ATP reserves are used up.

The body’s source of oxygen is the air in the atmosphere. Getting oxygen from the air to each cell in the body requires a complex and coordinated effort from the respiratory and cardiovascular systems. Every minute these systems work together to take in oxygen the body needs and get rid of the waste gases produced.

In this activity, you will meet a young girl who is struggling to breathe. As you work to diagnose her, you will investigate the structure of the respiratory system and consider what happens in the body when low levels of oxygen cause a person to gasp for even a simple breath.

Equipment

* Computer with Internet access
* Activity 3.3.1 Medical History – Visit #1 Resource Sheet
* Activity 3.3.1 Medical History – Visit #2 Resource Sheet
* Colored pencils or markers
* Laboratory journal
* Human Body System Organizer

Procedure

**Part I: Meet Melissa**

Melissa Martin, age 11, is finding it harder and harder to catch her breath during her normal activities. As you work your way through Lesson 3.3, you will analyze Melissa’s symptoms, research a diagnosis, and provide recommendations for treatment and control.

1. Obtain an Activity 3.3.1 Medical History – Visit #1 Resource Sheet.
2. Read the case notes provided for your patient. Highlight or underline any symptoms or relevant history you feel will be helpful in making a diagnosis. Research information from the medical history and physical exam as needed. Take notes in your laboratory journal.
3. Discuss Melissa’s case with your team. Brainstorm what might be going wrong and work together to come up with an explanation of Melissa’s symptoms.
4. Add your explanation to the appropriate section on the Medical History Resource Sheet. Discuss your theory with your teacher.
5. Research next steps for Melissa Martin. How can you confirm the diagnosis and begin to treat your patient?
6. Record any ideas in the *Recommendations* section of the Medical History document.
7. Discuss Melissa’s case as a class.

**Part II: Inside the Respiratory System**

1. Begin to investigate the structure and function of the respiratory system. Go to the National Geographic Health and the Human Body webpage on Lungs and Lung Information, accessible at <http://science.nationalgeographic.com/science/health-and-human-body/human-body/lungs-article.html?source=G4103&kwid=ContentNetwork|929422825>.
2. Read the introduction titled The Breath of Life in the mini window.
3. Select Lung Anatomy in the mini window. Click on either the lung diagram or the names of structures to see more information about the lobes, trachea, diaphragm, bronchi, and bronchioles.
4. Sketch a diagram of the respiratory system on a blank Human Body System Organizer. Label each of the components and write a brief description of each component’s function.
5. Select the Alveoli tab in the lower left corner. The diagram and names of structures should change to represent the smallest structures associated with the lungs. Again click on either the diagram or the names of the structures to see more information about the alveoli, bronchioles, and blood vessels. On the side or bottom of your Body System Organizer, describe the relationship between the bronchioles, alveoli, and blood vessels. Add a drawing or sketch if desired.
6. Select Lung Functions. Complete the interactive demonstration of lung function. Watch carefully what is happening in the alveoli. Make sure to continue through the entire animation.
7. View the Anatomy of Breathing animation available at <http://teachhealthk-12.uthscsa.edu/studentresources/AnatomyofBreathing3.swf>. Watch gas exchange on inhale and exhale, also paying attention to the role of muscles in respiration. Take notes about the process in your laboratory journal.
8. Click on *Take a Closer Look* to examine gas exchange at the level of the alveoli.
9. Complete Conclusion Questions 1 and 2.
10. Visit the American Lung Association site on asthma available at <http://www.lung.org/lung-disease/asthma/learning-more-about-asthma/>. Define asthma in your laboratory journal. Watch the *What is Asthma?* video to explore how asthma impacts normal functioning of the lungs. Take notes in your laboratory journal.
11. View the Kids Health video What Happens During an Asthma Flare-up available at <http://kidshealth.org/teen/videos/flare_up_vd.html>.
12. Answer Conclusion Question 3.

**Part III: Follow-up Visit**

1. Obtain an Activity 3.3.1 Medical History – Visit #2 Resource Sheet.
2. Read the updates to the Case History.
3. Review Melissa’s Peak Flow Chart. Note that average (or normal) peak flow for a patient of Melissa’s size is 267. The chart below describes the classification of peak flow values.

|  |  |  |
| --- | --- | --- |
| Normal Peak Flow Values | | |
| % of Normal Peak Flow: | Meaning: | Classification: |
| 80% - 100% | All is fine | Green Zone |
| 50% - 80% | Caution | Yellow Zone |
| Less than 50% | Medical Alert | Red Zone |

1. Calculate the value ranges that relate to the Green, Yellow, and Red zones for Melissa. List the values on the Medical History form under the graph and use colored pencils or markers to shade in the associated ranges of the peak flow chart.
2. Analyze Melissa’s peak flow graph as well as her descriptions of her symptoms and activities on each day of her diary. Describe conclusions about her condition on the *Explanation of Results* section of the Medical History Resource Sheet.
3. Read the Recommendations section of the report.
4. Answer the remaining Conclusion questions.

Conclusion Questions

1. The walls of the alveoli in the lungs are incredibly thin. Explain how this structure is related to function in the body.
2. Remember what you learned about diffusion in PBS or another science class. Use the principles of diffusion to explain why oxygen molecules in the tissues of the lung go into the blood, and then in other tissues the oxygen molecules leave the blood.
3. What changes inside the airways in the lungs lead to an asthma attack?
4. Explain how monitoring Melissa’s response to medication during wheezing events can help in making a clinical diagnosis of asthma.
5. Note that Melissa’s exam indicates a pulse ox value of 91%. What is this value and how can it be used to monitor overall health?
6. What environmental conditions might cause damage to the alveolar sacs, and what would be the consequences of that damage?
7. Describe how the muscular system is interconnected to the respiratory system. What role do muscles play in an asthma attack?
8. Describe the interaction between the cardiovascular system and the respiratory system. Make sure to include the words hemoglobin and carbon dioxide as well as relevant anatomy you have learned in this lesson.