

Lesson Title – What is the Concentration of CO₂ in Exhaled Air?

Length – 42 minutes

Standards and Benchmarks Addressed-

AFNR Career Cluster – Animal Systems Career Pathway Content Standards

Lesson 4.3 will address parts of the following performance elements:

AS.02. Performance Element: Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.

AFNR Career Cluster – LifeKnowledge® and Cluster Skills Content Standards

Lesson 4.3 will address parts of the following performance elements:

CS.04. Performance Element: Systems: Examine roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment.

CS.11. Performance Element: Scientific Inquiry: Utilize scientific inquiry as an investigative method.

National Science Education Standards

Unifying Concepts and Processes: As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Evidence, models, and explanation**
- **Constancy, change, and measurement**
- **Evolution and equilibrium**
- **Form and function**

Science as Inquiry – Content Standard A: As a result of their activities in grades 9-12, all students should develop understanding of

- **Abilities necessary to do scientific inquiry**
- **Understandings about scientific inquiry**

Physical Science – Content Standard B: As a result of their activities in grades 9-12, all students should develop understanding of

- **Chemical reactions**

Life Science – Content Standard C: As a result of their activities in grades 9-12, all students should develop understanding of

- **Interdependence of organisms**

- **Matter, energy, and organization in living systems**

Science and Technology – Content Standard E: As a result of their activities in grades 9-12, all students should develop understanding of

- **Abilities of technological design**
- **Understandings about science and technology**

Science in Personal and Social Perspectives – Content Standard F: As a result of their activities in grades 9-12, all students should develop understanding of

- **Personal and community health**

History and Nature of Science – Content Standard G: As a result of their activities in grades 9-12, all students should develop understanding of

- **Science as a human endeavor**

Common Core State Standards for High School Mathematics

Conceptual Category – Number and Quantity

Quantities	Reason quantitatively and use units to solve problems.
The Complex Number System	Represent complex numbers and their operations on the complex plane.

Conceptual Category – Statistics and Probability

Interpreting Categorical and Quantitative Data	*Summarize, represent, and interpret data on a single count or measurement variable.
Making Inferences and Justifying Conclusions	*Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
Using Probability to Make Decisions	*Calculate expected values and use them to solve problems.

Common Core State Standards for English Language Arts

College and Career Readiness Anchor Standards for Reading

Integration of Knowledge and Ideas	Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
---	--

College and Career Readiness Anchor Standards for Writing

Text Types and Purposes	Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
Text Types and Purposes	Write narratives to develop real or imagined experiences or events using effective techniques, well-chosen details and well-structured event sequences.
Research to Build and Present Knowledge	Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

Research to Build and Present Knowledge	Draw evidence from literary or informational texts to support analysis, reflection, and research.			
Objectives - Upon completion of the lesson, students will be able to:				
1. Identify the functions of the respiratory and circulatory systems with 100% accuracy.				
2. Explain the function of the respiratory and circulatory systems with 100% accuracy.				
3. Describe the process of gas exchange in external respiration with 100% accuracy.				
4. Determine the presence of carbon dioxide in exhaled air with 100% accuracy.				
5. Exhibit lab safety procedures and operate lab equipment with 100% accuracy.				
Lesson Type -	Informational	<u>Operational</u>	Managerial	
Modalities Addressed -	<u>Visual</u>	<u>Auditory</u>	<u>Kinesthetic</u>	
Multiple Intelligences Addressed -	<u>Verbal-Linguistic</u>	Naturalist	Musical	Visual-Spatial
	<u>Logical-Mathematical</u>	<u>Interpersonal</u>	Intrapersonal	<u>Bodily-Kinesthetic</u>
Essential Vocabulary –				
Alveolus (alveoli)	Aorta	Artery		
Atrium (atria)	Blood pressure	Bromthymol blue		
Bronchiole	Bronchus (bronchi)	Capillary		
Cardiovascular	Cellular respiration	Circulation		
Diaphragm	Diastolic	Diffusion		
Exhalation	External respiration	Heart		
Heart rate	Inhalation	Internal respiration		
Larynx	Lung	Pharynx		
Physiology	Pulmonary circulation	Pulse		
Respiration	Respiration rate	Sphygmomanometer		
Stethoscope	Systemic circulation	Systolic		
Titration	Trachea	Vena cava		
Ventricle				
Need of Lesson – While <i>Lesson 4.2 Putting the Puzzle Together</i> focused on the anatomy of animals, this and the following lesson focus on the physiology of the parts studied in anatomy. Physiology is the study of function of plant and animal bodies, systems, organs, tissues, and cells. Not all physiology lessons occur within this unit, digestive and reproductive physiology lessons are within the respective unit of study.				
The respiratory and circulatory systems are two of the most basic systems of life. Without the				

flow of blood and intake of oxygen, mammals and other vertebrates cannot survive for long. The respiratory and circulatory systems are closely related in their functions in the body.

The respiratory system exchanges oxygen from the air that cells need to survive with carbon dioxide, the product of respiration, to maintain a balance in the body. Breathing brings air from the atmosphere into the lungs where it is delivered to the blood and exchanged for carbon dioxide to be expelled back into the atmosphere. Blood serves as a carrier of oxygen (O₂) and carbon dioxide (CO₂) from the cells to the lungs.

The circulatory system works closely with the respiratory system. It moves the oxygen and carbon dioxide to and from the lungs. The major function of the circulatory system is to serve as a mechanism to deliver raw materials and remove wastes to and from the cells. The heart, the major organ of the circulatory system, serves as a pump for blood. It cycles blood from the veins in the body to the lungs where oxygen levels are replenished, back to the heart, and out to the organs in the body.

In this lesson, students will explore the effects of respiration and heart rate under various conditions. Conducting these studies on animals is challenging, so students will use themselves to test respiration and heart rate but should realize many domestic animal systems are quite similar to their own. They will be able to make inferences about animal systems as well as human systems.

Materials –

Per group of four students:

- ✓ 3 plastic cups
- ✓ 1 dropper bottle of .05 M sodium hydroxide
- ✓ 1 SEPUP tray
- ✓ 1 30 ml graduated cup
- ✓ 2 straws
- ✓ Bottled water

Per pair of students:

- ✓ 1 one-gallon plastic bag
- ✓ 1 straw
- ✓ 1 stir stick
- ✓ Stop watch

Per class:

- ✓ 4 dropper bottles bromthymol blue
- ✓ Indicator

Per student:

- ✓ Pencil
- ✓ Agriscience Notebook

Resources (Community, etc)

Curriculum for Agricultural Science Education (CASE)-Animal Science Curriculum (Copyright 2012). www.case4learning.org

Pre-Class Set-Up –

All lab materials needed for today’s lesson will be organized for students to retrieve at the front of the laboratory on a demonstrations table. Students will be responsible for obtaining all equipment needed for the lesson after the teacher demonstration.

Bell Work – *Please write the answer to your Bell Work on your weekly sheet.*

What is the difference between internal and external respiration?

(Internal respiration is the combustion of oxygen for the use of energy while external respiration is the exchange of oxygen and carbon dioxide between the lungs and the atmosphere.

Interest Approach – To review yesterday’s information about the interaction of respiration and circulation, I’ve created a “match game” that you will complete with your lab group. Working together, you have to place the path that blood travels in the correct order starting with the blood leaving the left ventricle. You will have 3 minutes to study your notes from yesterday.

(Give study time, then allow the teams to correctly order the flash cards).

Review correct sequence with students.

Aorta ~ Arteries ~ Arterioles ~ Capillaries of Body ~ Venules ~ Veins ~ Vena Cava ~ Right Atrium ~ Right AV Valve ~ Right Ventricle ~ Pulmonary Artery ~ Capillaries of Lungs ~ Pulmonary Vein ~ Left Atrium ~ Left AV Valve ~ Left Ventricle

Transition – Now that we have learned the physiology of the circulatory and respiration systems, we are going to investigate just how much carbon dioxide we exhale. Take the following items with you to the lab: Notebook and a pen/pencil.

Summary of Content and Teaching Strategies –

Today we are going to be completing a lab experiment to investigate just how much carbon dioxide is present as we exhale. Please turn to Activity 4.3.2. Take a Deep Breath in your lab notebook.

Teacher Demonstration of Lab Set-Up

I'm going to walk through the lab set-up because we have some new equipment that you haven't used before. (Utilizing procedure outlined in lab worksheet, demonstrate the way to set-up the SEPUP trays and outline the data that needs to be collected). (5 minutes)

Remember to follow the outlined procedure in your notebook. When your group has finished, be sure to wash out your equipment and place everything back on the front table and complete the conclusion questions at the end of your lab report. I'll be around to check that each individual has completed them before the end of the lab. Grab a pair of safety glasses and you may begin!
While students are working, monitor each lab group to see that the procedure is being followed and that all students are following safety guidelines.

Learning Assessment – Before the end of class, the instructor will verify the completeness and accuracy of the questions at the end of the lab exercise. Student responses will be valued at 10 points and will gauge the introductory activity of tomorrow's class to recap this lab exercise.

Cognitive Connect –

Yesterday – What Path Does Blood Travel in the Circulatory System?

Today – What is the Concentration of Carbon Dioxide in Exhaled Air?

Tomorrow – What Factors can Affect Respiration?

Adaptations/Accommodations for Special Needs – While the instructor is reviewing the laboratory procedure, he/she will instruct students to underline or highlight key instructions to aid in student success and retain attention. An abbreviated outline of instructions will be placed on the chalkboard for students to reference if procedures are unclear. Students requiring preferential seating will be granted a seat to aid in their comprehension during the teacher

demonstration. Finally, students requiring extended time to complete assignments will be granted the extension outlined in their IEP.

Total Ag Program –

FFA – This exercise would benefit students participating in the Veterinary Science Career Development Event (CDE). Students participating in this contest must be familiar with the anatomy and physiology of animals to be successful in this contest.

SAE – Students with an interest in Small Animal Care, Dairy Production, Beef Production, Sheep Production, Swine Production, and Goat Production would benefit from this lesson. In order to be a successful livestock producer, an individual must have the knowledge of animal anatomy and physiology to successfully diagnose diseases and communicate with veterinary professionals when needing assistance.

Lesson Summary

Which component(s) in your lesson plan are your “flex” item(s), i.e., can be lengthened or shortened to accommodate time? Explain how the component(s) can be “flexed”.

The flex item of this lab is compiling the class average for data and completing the conclusion questions. If the lab procedure runs longer than anticipated, the class data can be compiled at the beginning of tomorrow’s class while students work to individually complete their conclusion questions and have them evaluated by the instructor.

Describe any adaptations and accommodations for learners with special needs that can be made in this lesson plan.

While the instructor is reviewing the laboratory procedure, he/she will instruct students to underline or highlight key instructions to aid in student success and retain attention. An abbreviated outline of instructions will be placed on the chalkboard for students to reference if procedures are unclear. Students requiring preferential seating will be granted a seat to aid in their comprehension during the teacher demonstration. Finally, students requiring extended time to complete assignments will be granted the extension outlined in their IEP.

We learn in three modalities. Where in this lesson plan are your specific evidences of accommodating learners’ modalities?

Visual-Students will see a demonstration from the instructor that describes new equipment being used in today’s experiment. Additionally, instructions and procedures will be written in both the lab notebook and summarized on the chalkboard.

Auditory-Students will hear instructions given before they begin their experiment. In addition, students will be collaborating with their group members to increase their understanding of the purpose of the lab.

Kinesthetic-Students will answer the question, “How much carbon dioxide is in exhaled air” by utilizing sound scientific principles and methods.

What is the highest level of cognition according to Bloom’s Taxonomy that students reach in this lesson plan? Describe this occurrence.

The highest level of cognition reached is Analysis. Students reach this level as they must determine the darkness of the bromethymol blue in their procedure. Determining the darkness is directly correlated to how much carbon dioxide is in exhaled air.