

## Indoor Air Pollutant Sensing

### LAB Lead-In: A Canary in a Coal Mine?

#### Purpose

To learn the physiology of carbon monoxide poisoning and the historical use of sentinels as warning indicators.

#### Overview

After reading a student worksheet describing cases of miners and carbon monoxide poisoning, students will investigate the causes of carbon monoxide in mines and other common sources of CO. Students will also discuss ethical issues regarding treatment of miners (historically) and the use of animals as sentinels. This activity leads directly into, and is a partner with, the Peppermint Diffusion Lab.

#### Time

Two class periods – One period for the student worksheet and class discussion, research to be done for homework, and one period for continued research (with or without a group) and presentation of findings.

#### Key Concepts

Hemoglobin molecules release carbon dioxide at the lung and pick up oxygen. When carbon monoxide attaches to hemoglobin, it never lets go – putting the hemoglobin out of commission within the oxygen delivery system.

Canaries were used in mines to warn miners of possible danger if they released a pocket of carbon monoxide.

#### Skills

Generating questions  
Communicating orally and in writing  
Organizing research material  
Working in a group

#### Materials

Student Worksheet  
Research Materials (computers/internet or access to the library)

#### Facilitator Preparation

Let students read the worksheet “Canary in a Coal Mine” before beginning any classroom discussion on carbon monoxide poisoning. Students should develop their own ideas about canaries used as sentinels.

#### Procedure

1. Pass out the student worksheet “Canary in a Coal Mine?”
2. Whole class discourse to follow students reading of the worksheet on carbon monoxide poisoning.
3. Individual or group research of carbon monoxide poisoning. Here are some possible questions to be investigated:
  - a. Why is carbon monoxide found in pockets of coal?
  - b. How is it formed?
  - c. Where else might carbon monoxide be found in your environment?

- d. What are risk factors for carbon monoxide poisoning?
- e. Is there a possibility that you can come in contact with carbon monoxide during your day?
- f. What are some contemporary sources of this gas?
- g. What are health effects of carbon monoxide poisoning?
- h. How would you protect yourself or your family from carbon monoxide poisoning?
- i. What do you find as the most startling fact about carbon dioxide?

### **Student Assessment**

1. After reading the worksheet, students discuss their feelings regarding the reading “A Canary in a Coal Mine”. Were they aware of this potential environmental health problem before reading the piece?
2. Before discussing the physiology of carbon monoxide poisoning, have students write down what they identify as problems for miners in the early nineteenth century. Establish what they already know about carbon monoxide poisoning and what they think they need to know to begin their research. Students are encouraged to work in groups as they write down their ideas.
3. Students work individually or in groups as they investigate the sample questions listed in the procedure (or questions of their own).
4. Give the following presentation design components to each student as a guide to their presentations:
  - ❖ Decide what is important about their findings
  - ❖ Design an overhead that summarizes the information
  - ❖ Were proper environmental health terms used?
    - ❖ Did the presenter report their source?

### **Ethics Component:**

1. Direct students to the second paragraph in the reading. What are the ethical issues involved?
2. Have students read through the worksheet again and find another place within the reading involving ethics and possible opposing opinions. (HINT: think about animal rights).

### **A Canary in a Coal Mine?**

By the early nineteenth century, Europe and the United States had moved into what is now referred to as the Industrial Revolution. Inventions of the past few decades had replaced workers. Factories now consisted of machinery driven by the fossil fuel of that time – coal. With more machinery and engines requiring more and more fuel, the coal mining industry was experiencing a boom, a rapid increase in demand for the product, coal. Coal miners were usually the factory workers who had been replaced by the new machines. They now toiled in dark tunnels deep inside the earth to bring this new precious fuel to the surface and on to the factories and machines that needed it.

The owners of the coalmines knew the coal miners needed their jobs desperately. Therefore, not much attention was paid to worker safety. At this time, during the Industrial Revolution, there were no safety regulations and no unions to represent the rights of the workers. The workers were at the mercy of the owners of the coalmines who wanted to maximize their profits.

While chipping away at a vein of coal, quite often the miners would hit a pocket of gas, carbon monoxide (CO), which had developed with the coal over million of years. This trapped gas was colorless, odorless, and deadly.

When miners hit these pockets of carbon monoxide, they would become drowsy and tired, and would then pass out. They would continue breathing the odorless deadly gas until they died. Often no one would even be aware that a pocket of this gas had killed a team of miners until someone noticed that no carts full of coal had come up from that section of the mine in a while. Someone would investigate and immediately run out of the mine upon finding the dead miners, knowing that the gas was still in that vein of the mine.

### **The Poor Canary**

Someone suggested putting a canary in a cage in each spot there was a team of miners working. The canary was used as a signal if the miners had hit a pocket of carbon monoxide. When the canary stopped singing or died, the miners dropped their tools and headed for the surface.

It may have been an odd sight to see a pretty yellow bird in a cage down in a deep, dirty mine singing to a bunch of burly, soot-covered miners, but the miners knew that the canary would save their lives.

Today, the expression “canary in a coal mine” is used to refer to something that indicates a warning, a sign to take notice of a negative change that has taken place.

## **Indoor Air Pollutant Sensing LAB Lead-In: A Canary in a Coal Mine? Work Sheet**

**Why were canaries used in the mines?**

**Describe the physiology of Carbon Monoxide Poisoning.**

**Other possible questions to be investigated:**

1. Why is carbon monoxide found in pockets of coal?
2. How is it formed?
3. Where else might carbon monoxide be found in your environment?
4. What are risk factors for carbon monoxide poisoning?
5. Is there a possibility that you can come in contact with carbon monoxide during your day?
6. What are some contemporary sources of this gas?
7. What are health effects of carbon monoxide poisoning?
8. How would you protect yourself or your family from carbon monoxide poisoning?
9. What do you find as the most startling fact about carbon dioxide?