

## Indoor Air Pollutant Sensing LAB: Peppermint Diffusion

### Purpose

To learn about the sensory experience of diffusion as the molecules of peppermint flavoring are interspersed among the air molecules in a classroom.

### Overview

This activity is a sensory experience of diffusion, followed by a whole class discussion to construct an understanding of the concept. Peppermint flavored liquid is placed in the back of the classroom with the scent gradually dispersing through the room. The time and direction that the scent is traveling is recorded until the room is in equilibrium with equal distribution of peppermint and air molecules.

This activity should follow the "A Canary in a Coal Mine?" activity since the 'canary in the coal mine' is mentioned in a couple of the questions in the assessment section.

### Time

1 class period

### Key Concepts

Diffusion is a system's attempt to reach equilibrium.

A concentration of molecules will diffuse into the air in a room until they are equally distributed throughout the room.

Once equilibrium is reached, as long as the system is closed, molecules will continue to circulate in an equilibrium state

If the system becomes an open system, molecules will diffuse again, trying to reach an equilibrium state, until all molecules are distributed equally.

### Skills

Making observations

Testing hypotheses

Making predictions

Communicating observations and interpretations orally and in writing

### Materials

Cotton balls

Peppermint oil flavoring

Overhead transparency and markers

### Facilitator Preparation

Do not tell the students ahead of time that they will be participating in this activity. The peppermint will be placed in the back of the room before students enter the class.

Before the activity begins, make a copy of the seating chart of your classroom for use in marking the responses to the diffusion of the peppermint. An overhead transparency is best so that the data can be shared with the learners during the discussion. Use numbers to identify the successive observations of the scent (first student smelling peppermint in labeled "1", second student getting a whiff of the scent is "2", and so on).

Also before the activity begins, turn off the air conditioner and close the windows to minimize mixing by the air currents and breezes.

This activity should follow the "A Canary in a Coal Mine?" carbon monoxide poisoning activity since the 'canary in the coal mine' is mentioned in a couple of the questions in the assessment section. Students will be able to assess the final scenario and answer questions without previously reading the carbon monoxide poisoning activity if the class has had a previous discussion of odorless gases - specifically, the off gassing of carbon monoxide.

### Background

Diffusion is a system's attempt to reach equilibrium. The concentrated peppermint molecules will diffuse or spread out into the air in the room until they are equally distributed throughout the room. They do not stop moving once this equilibrium has been reached, but as long as the room is closed, they will continue to circulate in an equilibrium state. The air as well, has diffused into the peppermint area until the air has equally distributed itself in with the peppermint molecules. The room is in equilibrium, until the door is opened or someone pulls out a bottle of perfume then all molecules will do the equilibrium dance again, until all are distributed equally.

### Procedure

1. Before the class enters the room, place a cotton swab of peppermint-flavored liquid in a far corner of the room away from the door through which the students enter. You should have already turned off the air conditioner and closed the windows.
2. Wait until someone mentions the scent. Say, "Does anyone else smell mint?"
3. Ask the group smelling the peppermint, "How long have you been smelling it?" Look at the clock and mention the time. Say, "Maybe the cafeteria is making a special dessert today?" Record the time on the seating chart next to the number "1".
4. As others smell the peppermint, record the time and notice the direction in which the observed scent is traveling. Say, "Wow, now ... is smelling it! When you smell the scent, say to me, 'Okay, now I'm smelling it.'"
5. At some point, a curious student may discover the scented cotton ball. Ask them to leave the cotton in place and ask the now-aware remaining students to report to you when they can detect the scent.
6. If no one discovers the cotton ball, continue until everyone can detect the scent. Say, "Okay, now we all can smell it. Where do you think it's coming from?" Let the students investigate and construct that it must have come from the direction of the first group to notice the scent.
7. Show the overhead transparency with your data at this point.
8. Discuss the data and how diffusion of air molecules works in reaching equilibrium in your closed classroom. Compare closed and open systems by describing to students how you closed all the windows before the activity and have students predict what would happen when you open the door of the classroom.
9. Have students write an essay assessing the following scenario, answering the questions at the end of the piece - along with any opinions they might have about the story.
10. The activity, "A Canary in a Coal Mine?", is mentioned in a couple of the questions. Students can assess the following scenario (enclosed Extension Exercise) with or without previously reading the "A Canary in a Coal Mine" activity if the class has had a previous discussion of odorless gases - specifically, the off-gassing of carbon monoxide.

### **Further Investigation**

Now that students understand how molecules of certain concentrations diffuse among air molecules - constantly trying to reach a state of equilibrium, ask students to think about pollutants traveling in the air. How do they think this process of pollutants always trying to reach a state of equilibrium in the air we breathe might affect human health? Do they have any ideas as to good websites that might help them find some answers?

Have the students investigate websites such as Consumer Reports, EPA, NIEHS, and CDC. Encourage them to find relevant websites on their own and report back to the class.

### **Student Assessment**

- ❖ Did the students actively participate in the class discussions of the peppermint odor and gas diffusion?
- ❖ Did the students write an essay assessing the Extension Exercise, answering the questions at the end of the piece - along with any opinions they might have about the story?

## **Indoor Air Pollutant Sensing LAB: Peppermint Diffusion Extension Exercise**

You are moving into your first apartment. You have saved enough money to put in new carpet and buy new furniture. The carpet is installed. It has a new chemical smell to it. The new furniture has arrived. It is wood, stained to match your color scheme. It has a pleasant furniture scent to it. The couch's pillows are firm and new, with just the right softness when you sit on them. The dining room chairs have been upholstered with a fabric that is dirt resistant. Spills just wipe right off. Your eyes seem dry and irritated for a while but you figure it's just the pollen in the air.

Months pass and the fresh, new odors disappear. So does your eye irritation. The dining room chairs do not repel dirt like they did when they were new.

### **Questions**

1. What is the connection between the 'canary in the coal mine' and the new furniture and rugs off gassing in your apartment?
2. What was the message of the canary in the coal mine? Is there a lesson here?
3. List the clues to off gassing of chemicals. What has happened?
4. Are there some chemicals that perhaps you could not smell?