

Teaching Suggestions

Science and Mathematics Lab

(Course 1, Lesson 10-8; Course 2, Lesson 8-1; Course 3, Lesson 5-5)

Smoke Pollution

OVERVIEW

This activity provides students with the opportunity to learn how environmental scientists identify sources of air pollution by estimating the visual percent density of smoke. Students will be required to estimate the percent density of smoke from photographs and from burning incense.

RECOMMENDED TIME

1 class period

MATERIALS

- 10-cm \times 20-cm piece of cardboard (thin)
- glue or paste
- Ringelmann Chart
- scissors
- incense
- matches

PREPARATION

Look in magazines for photographs of forest fires, building fires, oil well fires, and smokestacks. Find a variety of photos of smoke emission for students to examine.

TEACHING THE LAB

1. Have students work individually.
2. You may need to explain that adding black to white results in gray. One way to demonstrate this is by adding black ink or watercolor paint to a glass of water. Add the paint or ink drop by drop while stirring to show how the water darkens as more black is added.
3. Light the incense and allow students to observe the smoke. Caution students not to hold their Ringelmann Charts too close to the burning incense.
4. Caution students not to inhale the smoke.

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Smoke Pollution (continued)

Answers and Conclusions

1. The relative amount of pollution entering the atmosphere is 70%.
2. Sample answer: Wind usually disperses smoke and may carry it to a location that has clean air.
3. Sample answer: oil refineries; power plants
4. Yes, some gases are colorless and can cause injury in small amounts and over short periods of time.

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Smoke Pollution

INTRODUCTION

The U.S. Bureau of Mines has adopted the Ringelmann Chart as its basic scale for measuring smoke pollution. The Ringelmann Chart is often used in making visual estimates of the amount of solid matter emitted by smokestacks. The observer compares the color of the smoke with a series of shaded columns. The shaded columns represent increasing percent densities of smoke as visually measured against a white background. Using an adapted version of this chart, you can identify sources of smoke pollution.

OBJECTIVES

In this lab, you will:

- observe a smoke source and estimate the visual percent density of the smoke.

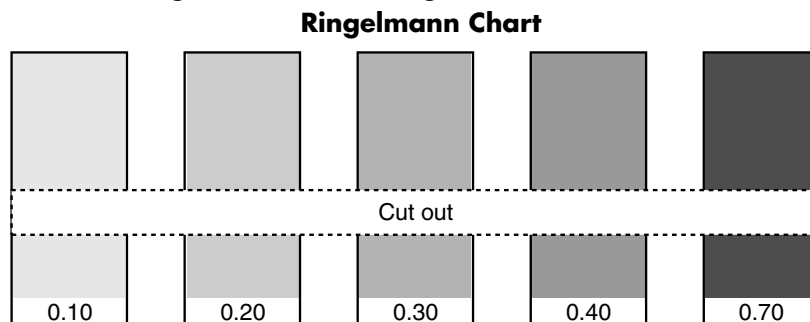
MATERIALS

- 10-cm \times 20-cm piece of cardboard (thin)
- scissors
- glue or paste
- incense
- Ringelmann Chart

PROCEDURE

Part 1

1. Cut out the Ringelmann Chart and glue it to the cardboard.



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Smoke Pollution (continued)

- When the glue is dry, cut out the center window by cutting along the dotted lines.
- Hold up your card and view the smoke from the burning incense through the center window.
- Match the color of the darkest part of the smoke plume to one of the columns on your Ringelmann Chart.
- Record the percent density in the Data Table.

Part 2

- Observe the smoke in three different color photographs.
- Place your card over the darkest part of the smoke in the photograph.
- Match the color of the darkest part of the smoke plume to one of the columns on your chart.
- Record the percent density in the Data Table.

DATA AND OBSERVATIONS

| Description of Smoke Source | Percent Density |
|-----------------------------|-----------------|
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Questions and Conclusions

- The 0.20 on the Ringelmann Chart indicates that the relative amount of pollution entering the atmosphere is 20%. What does the 0.70 value indicate about the relative amount of pollution entering the atmosphere?
- How do you think wind would affect smoke pollution?
- What types of industries produce the air pollutants in your local area?
- Some companies emit invisible gases. Might these gases also be pollutants? Explain.