

# What You Can't See

## Diffusion of Ammonia Gas



### Introduction

Harmful gases can sometimes be invisible. It is important to always take proper safety precautions any time gases or volatile liquids will be used in the laboratory.

### Concepts

- Gas diffusion
- Acid–base indicators
- Laboratory safety
- Properties of ammonia
- Gas laws

### Materials

#### Option 1:

Ammonium hydroxide,  $\text{NH}_4\text{OH}$ , 6 M, 1–2 mL

Phenolphthalein solution, 1%, 2 mL

Water, distilled

Beral pipets

Overhead projector

Petri dish, divided, with cover

#### Option 2:

Ammonium hydroxide,  $\text{NH}_4\text{OH}$ , 6 M, 1–2 mL

Phenolphthalein solution, 1%, 2 mL

Beral pipets

Clear plastic or glass tube, 1–4 cm diameter, 30–60 cm length

Cotton balls or absorbent tissue

Ring stand and clamp

### Safety Precautions

*Ammonium hydroxide is toxic by ingestion and inhalation and corrosive to body tissue. Phenolphthalein is an alcohol-based solution and is flammable. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.*

### Procedure

#### Option 1

1. Place the divided Petri dish on an overhead projector.
2. Using a Beral-type pipet, add 1–2 mL of ammonium hydroxide solution to one compartment in the divided Petri dish.
3. Mix 1 mL of phenolphthalein solution with 1 mL of distilled water in a second compartment.
4. Place the cover on the divided Petri dish.
5. Turn the overhead projector on.
6. Observe. The phenolphthalein solution will start out colorless and then turn hot pink or bright red within minutes.

#### Option 2

1. Position the clear glass or plastic tube horizontally using a ring stand and clamp.
2. Soak a cotton ball with 1 mL of phenolphthalein solution and 1 mL of distilled water.
3. Insert the phenolphthalein-soaked cotton ball into one end of the tube making sure that the phenolphthalein solution faces into the tube.
4. Wash hands to make sure all the phenolphthalein is removed from your hands or wear latex gloves and then remove them later. If any phenolphthalein is transferred to the ammonium hydroxide cotton ball, it will immediately turn bright red.

5. Place 1 mL of ammonium hydroxide on the other cotton ball.
6. Insert the ammonium hydroxide-soaked cotton ball into the other end of the tube.
7. Observe. Depending on the length of the tube, the phenolphthalein-soaked cotton ball will begin to turn red in a few minutes.
8. Another option is to soak a cotton ball with water as a control. Ask your students if they see any indication of gases in the tube. Next, repeat the experiment as described above. Is there any indication now?

## Discussion

This demonstration is a modification of the Graham's Law demonstration that uses hydrochloric acid and ammonium hydroxide. In this demonstration, there is only one gas and a stationary indicator. Phenolphthalein is an acid-base indicator and turns red when exposed to a base. Ammonium hydroxide is a concentrated solution of ammonia gas in water. Ammonia is a base and very volatile.

The indicator color changes provide a visual reminder how quickly toxic gases can travel. Since many gases cannot be seen or smelled, this demonstration reinforces two important safety practices—work in a well-ventilated room, and carry out any reactions that may produce toxic fumes in a fume hood.

## Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

***Unifying Concepts and Processes: Grades K–12***

Evidence, models, and explanation

Evolution and equilibrium

***Content Standards: Grades 5–8***

Content Standard B: Physical Science, properties and changes of properties in matter

Content Standard F: Science in Personal and Social Perspectives; personal health

***Content Standards: Grades 9–12***

Content Standard B: Physical Science, structure and properties of matter, conservation of energy and increase in disorder

Content Standard F: Science in Personal and Social Perspectives; personal and community health

## Acknowledgment

Special thanks to John Brodemus, Richards High School, Oak Lawn, IL for sharing this idea with us.

**Materials for *What You Can't See—Diffusion of Ammonia Gas* are available from Flinn Scientific, Inc.**

Catalog No.	Description
A0174	Ammonium Hydroxide, 100 mL
P0019	Phenolphthalein Solution, 1%, 100 mL
GP9146	Demonstration Tube
AB1471	Petri Dish, Disposable, Partitioned

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.