

Gee Whiz Effusion of Gas

Diffusion of Gases

Introduction

A quick and simple demonstration to show a gee-whiz example of gaseous effusion.

Concepts

- Kinetic molecular theory
- Graham's law of effusion

Materials

Beaker, 400-mL

Cylinder regulator with tubing

Food coloring, 3 mL

Hydrogen gas cylinder

Glass tubing, 5–10 cm

Porous cup

Rubber stoppers, 1-hole, #7 and #3

Wash bottle, filled with water

Safety Precautions

Hydrogen is a very flammable and potentially explosive gas but can be safely handled with proper safety procedures. Never generate hydrogen in a closed system; always make sure there are no plugs or blockages in the system. Remove all sources of sparks, flames, and heat from the area where hydrogen gas is produced or used. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please consult current Material Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

1. Put the glass tubing through the #3 one-hole rubber stopper. Put the #7 one-hole stopper through the same glass tubing so that the tops of the stoppers touch.
2. Add 3 mL of food coloring to the water in the wash bottle. Put the bottom of the rubber stopper firmly into the opening of the wash bottle. Place the porous cup firmly on the #7 stopper.
3. Place the assembly on the opening of the wash bottle (see Figure 1).

Procedure

1. Invert the 400-mL beaker and place it over the porous cup. Nothing should occur.
2. Remove the 400-mL beaker keeping it inverted and this time fill it with hydrogen gas.
3. Place the inverted beaker over the porous cup. Water will shoot out the nozzle of the wash bottle

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. The final solution may be rinsed down the drain according to Flinn Suggested Disposal Method #26b.

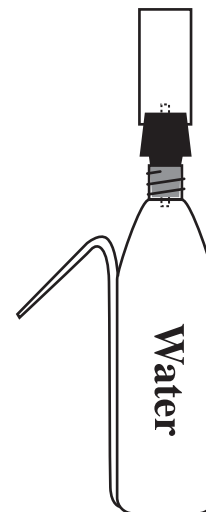


Figure 1.

Connecting to the National Standards

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

Unifying Concepts and Processes: Grades K–12

Systems, order, and organization
Evidence, models, and explanation

Content Standards: Grades 5–8

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

Content Standards: Grades 9–12

Content Standard B: Physical Science, structure and properties of matter

Discussion

Effusion involves the movement of gas particles through tiny openings in a container. A porous cup is just such a container. Its sides and bottom are porous to the flow of gases. Thomas Graham (1805–1869) discovered that the rates of effusion of two gases were inversely proportional to the square roots of their molar masses.

$$\frac{\text{Rate of effusion of gas}_1}{\text{Rate of effusion of gas}_2} = \frac{\sqrt{\text{molar mass of gas}_2}}{\sqrt{\text{molar mass of gas}_1}}$$

This is known as Graham's law. The hydrogen, being lower in molar mass than "air," moves faster into the porous cup than air moves out of the cup. This increases the pressure inside the wash bottle, causing the water to stream out of the nozzle. If a heavier gas, like carbon dioxide, CO₂, or sulfur hexafluoride, SF₆, was used instead of hydrogen, then the air would be forced into the wash bottle.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Gee Whiz Effusion of Gas* activity, presented by Lee Marek, is available in *Diffusion of Gases*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Gee Whiz Effusion of Gas* are available from Flinn Scientific, Inc.

Catalog No.	Description
LB1070	Hydrogen Cylinder
LB1052	Control Valve, Stainless Steel
AP1312	Porous Cup

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