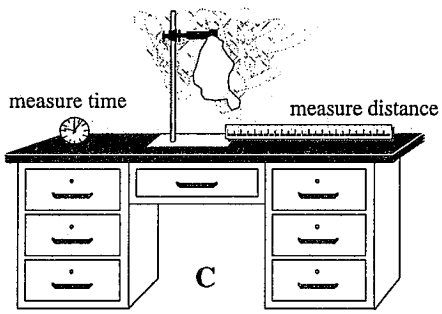
2.3.2 DIFFUSION OF GASES

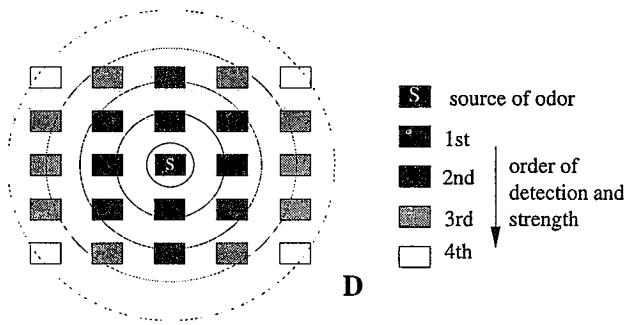
Concepts to Investigate: Diffusion, odors.

Materials: Measuring tape or meter stick, liquid with a strong but safe odor (e.g., air freshner, vinegar, perfume, onion juice, cologne).

Principles and Procedures: Note: this activity works best when the air is very calm. Soak a rag in a jar of perfume, vinegar, cologne, or onion juice (a solution of onion juice can be made by puréeing an onion in a blender and then soaking the product in a small amount of water). Remove the rag and suspend it from a ring-stand or place it on a table in the middle of the room (Figure C). Reseal the jar immediately. (Alternatively, you may wish to spray short bursts of air freshener.) Each student in the class should raise his or her hand the moment they first detect the odor (Figure D). Record the time when each student raises his or her hand and the distance from the student to the source of the odor. Calculate the rate of diffusion to each individual in the class by dividing the distance from the object by the time required for the student to detect the odor. Do you predict that odors will be detected sooner on a warm day or a cool day? If possible, repeat this activity when the air temperature is considerably different. Do the molecules diffuse faster when the temperature is warmer or cooler?



C



D

Questions

(1) Which students detected the odor first? Which detected it to be strongest? Explain.
(2) The fragrance of flowers is stronger on warm days than on cool days. Explain.
(3) Party balloons filled with hydrogen (atomic number 1) or helium (atomic number 2) collapse in a short time. Explain.

2.3.3 THE EFFECT OF TEMPERATURE ON DIFFUSION

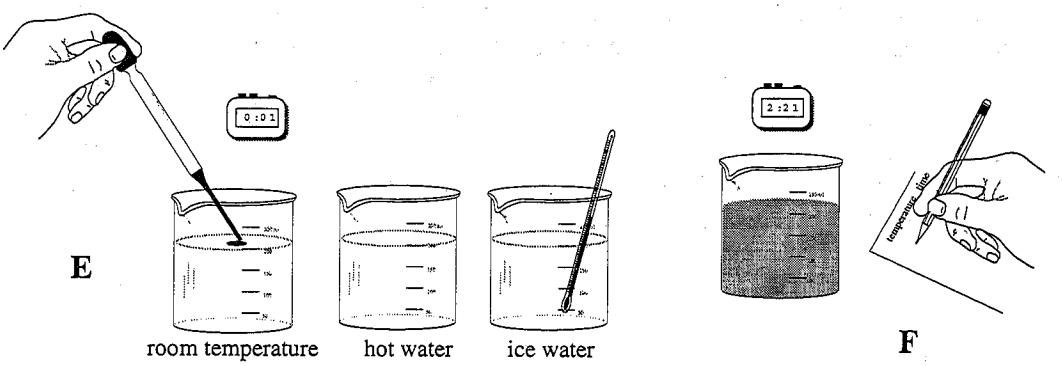
Concepts to Investigate: Diffusion rates, kinetic theory, molecular motion.

Materials: Part 1: Beakers (or clear drinking glasses), pipets (or medicine dropper), food coloring, time pieces; Part 2: Perfume, vinegar, cologne or onion juice; rag, ice.

Principles and Procedures:

Part 1: The effect of temperature on diffusion in liquids: Obtain three beakers or clear drinking glasses. Fill one with ice water, one with room temperature tap water, and one with hot tap water. Place white paper underneath and behind the containers to highlight diffusion of the dye. Use a pipet or medicine dropper to place a single drop of concentrated food coloring on the surface of the liquid in each beaker as shown in Figure E. Record your observations regarding the rate of diffusion of the dye in each beaker. Record the time required for the color to become uniform throughout the container (Figure F).

Part 2: The effect of temperature on the rate of diffusion in gases: Place a rag in a container of perfume, vinegar, cologne or onion juice. Place the container in an ice water bath until the temperatures have equilibrated. Open the jar, place the rag on a desk in the center of the room (Figure C in 2.3.2), and reseal the container. Each student in the class should raise his or her hand the moment they first detect the odor (Figure D in 2.3.2). Record the time each student raises his or her hand and the student's distance from the source of the odor. On day 2 repeat the process after soaking the container in a water bath at room temperature. On day 3, repeat the process after soaking the container in a hot water bath (approximately 60°C).



Questions

(1) According to your observations, describe the change in the diffusion rate of the dye as the temperature is increased in part 1.

(2) How does the diffusion rate of odorous material change as the temperature is increased in part 2?

(3) Are the odors associated with horse stables, gasoline stations, and soiled socks more noticeable on hot days or cool days? Explain.