

Splatter Test

Introduction

Evaporation is an excellent topic to introduce the forces that influence vapor pressure and boiling point.

Concepts

- Vapor pressure
- Boiling point
- Hydrogen bonding
- Evaporation

Materials

Acetone, $\text{C}_3\text{H}_6\text{O}$, 5 mL

Ethyl alcohol, $\text{C}_2\text{H}_6\text{O}$, 5 mL

Water, H_2O , 5 mL

Beral-type pipets, 3

Blackboard

Safety Precautions

Acetone and ethyl alcohol are flammable liquids, keep away from heat, sparks, or flames. They are also slightly toxic by ingestion and inhalation. Perform this demonstration in a well-ventilated room. 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

1. Draw the structures of acetone, ethyl alcohol, and water on the blackboard (see Figure 1).

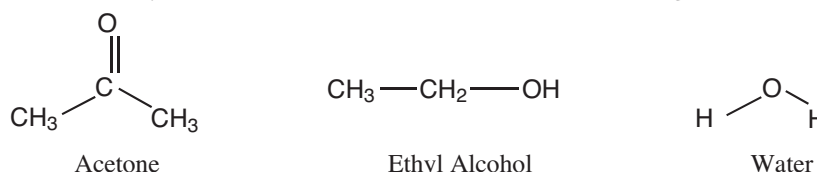


Figure 1.

2. Enlist some volunteers to help with the demonstration. Steps 3–5 should be done simultaneously.
3. Squirt several milliliters of water onto the chalkboard under the structure of water.
4. Squirt several milliliters of ethyl alcohol onto the chalkboard under the structure of ethyl alcohol.
5. Squirt several milliliters of acetone onto the chalkboard under the structure of acetone.
6. Observe.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. There is no disposal required for this demonstration.

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

Form and function

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 of atoms, structure and properties of matter

Discussion

Evaporation is the gradual change of state from liquid to gas that occurs at a liquid's surface. The rate of evaporation of a particular substance depends on the temperature or average kinetic energy of the molecules. The difference in evaporation rate between different substances is due to the intermolecular forces holding the liquid together.

Molecules are “held together” in the condensed phases (liquids and solids) by intermolecular forces. Intermolecular forces are defined as attractive forces between molecules. There are three kinds of intermolecular forces—dipole-dipole interactions, hydrogen bonding, and dispersion (London) forces. These forces vary in strength, with hydrogen bonding being the strongest, and London forces the weakest.

Dipole-dipole interactions are electrostatic attraction between the negative end of one molecular dipole and the positive end of another dipole. These interactions apply only to polar molecules.

Hydrogen bonding is a special case of dipole-dipole forces with very specific structural requirements. It always involves a hydrogen atom attached to a strongly electronegative element such as F, O, N, Cl. This hydrogen atom is attracted to and shares electrons with a nonbonded pair of electrons on an atom in an adjacent molecule. For example, water forms an intricate hydrogen bonded network between the hydrogen and oxygen atom with neighboring molecules (see Figure 2).

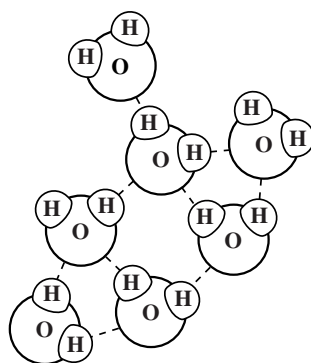


Figure 2.

Dispersion or London forces are present in all molecules regardless of being polar or nonpolar. They arise due to “induced polarization” of bonds within molecules, creating random, instantaneous dipoles due to electron motion. These weak, short-lived dipoles also attract each other.

In this demonstration, acetone evaporates the fastest, followed by ethyl alcohol and then water. This is due to the strong hydrogen bonding in water and to a lesser extent in ethyl alcohol. The acetone also spreads out the most when it hits the surface of the board. Water will form little streams and does not spread out as much. This is due to the large surface tension in water caused by the hydrogen bonding.

Materials for the *Splatter Test* are available from Flinn Scientific, Inc.

Catalog No.	Description
A0009	Acetone, 500 mL
E0009	Ethyl Alcohol, 500 mL

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