

11.1 Oil, water, and dish soap (Intermolecular forces I)

Subjects: Properties of liquids, intermolecular forces

Description: Cooking oil and water are used to illustrate that polar and non-polar substances do not mix. When dish soap is added, an emulsion is created by allowing the dispersion of oil into water.

Materials:

Cooking oil

Water (optional: add food coloring to make it more visible)

Dishwashing soap

2 500 mL Erlenmeyer flasks with stoppers

Procedure:

Note: Use the demo camera to display the procedure.

1. Pour water and oil into one flask. Observe how the oil “floats” on top of the water and that they don’t mix spontaneously.
2. Stopper and agitate to create an emulsion. Let the mixture stand and within a few moments, the layers will separate.
3. Add oil, water and dish soap to the second flask.
4. Shake the flask to mix the contents. In the presence of the emulsifier, the emulsion will persist.

Discussion:

“Like dissolves like”. Water and ethanol will mix to form a homogenous mixture, but oil and water do not. Both water and ethanol are polar molecules. They mix because of the ability of their dipoles to interact. The energy of attraction between the two molecules is enough to overcome the energy expended in mixing. Oil is non-polar and thus there is no attraction between the two molecules.

An emulsion is a dispersion of one liquid into another. An emulsifying agent is added to attain stability of the emulsion. Some examples of emulsions are homogenized milk, butter, mayonnaise, and gravy. In mayonnaise the egg yolk is the emulsifier and in gravy flour is the emulsifier that allows the water and the fat to mix. In this demonstration, the dish soap is the emulsifying agent. The emulsifying action of soap allows grease and oil to be removed from objects being cleaned.

Safety: None

Disposal: Solutions can be poured down the drain.

References:

1. B.Z. Shakhshiri; *Chemical Demonstrations: A Handbook for Teachers of Chemistry*; Volume 3; Wisconsin; 1989; p. 351-352
2. NCSU Chemistry Department Lecture demonstration website:

<http://www.ncsu.edu/project/chemistrydemos/DemoList.html>