

Teacher Set Up: Making the Attraction Real

Demo 1: Bending Water

MATERIALS NEEDED:

- buret w/ stand
- colored water (makes it easier to see)
- beaker
- balloon

PROCEDURE:

1. Fill the buret with the colored water
2. Charge the balloon by rubbing it on jeans, or a kimwipe
3. With a beaker under the buret, have a slow but steady stream coming from the buret
4. Hold the balloon next to the stream of water to pull it sideways

ADDITIONAL COMMENTS:

When the water is pulled sideways it can overshoot the beaker, causing a mess. A large beaker or a large amount of paper towels can make this demo less of a cleanup.

WHAT IS HAPPENING:

The balloon collects a small charge when it is rubbed. This charge attracts the water, which is polar, pulling it towards the balloon. This would be a hydrogen bond (between water molecules) and an induced dipole on the balloon.

Demo 2: Oil, Water, and Dish Soap

Items Needed

- Glass Jar with a lid (a pint canning jar works great or an Erlenmeyer with a stopper)
- Water
- Food Coloring (for effect and illustrative purposes)
- Oil (vegetable oil is fine)
- 2 teaspoons Dish Soap

Instructions

1. Fill the flask halfway with water.
2. Add a few drops of food coloring to the water and stir until combined.
3. Pour oil into the flask.
4. Securely tighten the stopper on the flask and shake it for 15-20 seconds.
5. Set the flask down and watch the liquid for a minute or two. *At this point, the oil and water will separate.
6. Next, take the stopper off the flask and squirt in 1-2 teaspoons of dish soap.

7. Tighten the stopper back and shake again for another 15-20 seconds.
8. Set the jar down and watch the liquid for a minute or two. *At this point the oil and water won't separate.

What is happening:

The oil is nonpolar, and the water is polar, so very little IMF happen between the two. Thus, they separate. However, soap has both polar and nonpolar qualities, thus attracting the water in a dipole-dipole and the oil in an induced dipole/London dispersion force.

Demo 3: Mixing water and ethanol

Materials

- Ethyl alcohol, anhydrous, C₂H₅OH, 500 mL
- Volumetric flasks, 500 mL, 2
- Water, distilled or deionized,
- 500 mL Volumetric flasks, 1 L,
- 1 Food coloring, yellow and blue

Procedure

1. Carefully measure out exactly 500 mL of water in a 500-mL volumetric flask. Add yellow food coloring to the water.
2. Carefully measure out exactly 500 mL of anhydrous ethyl alcohol into a second 500-mL volumetric flask. Add blue food coloring to the alcohol.
3. Pour the alcohol into the 1-L volumetric flask.
4. Carefully pour the water into the 1-L volumetric flask.
5. Observe that the final volume of liquid in the cylinder is less than 1000 mL or 1 L.

Disposal

The resulting solution may be flushed down the drain with excess water according to Flinn Suggested Disposal Method #26b.

Tips

- This demonstration is even more spectacular if done in a 24" glass demonstration tube. Fill the tube with equal volumes of deionized water and anhydrous ethyl alcohol, stopper the ends and begin to mix the solvents by turning the tube. An air bubble will soon appear out of nowhere. Adding equal volumes of water and ethyl alcohol to a volumetric flask also works well.
- Anhydrous ethyl alcohol does not contain any water. Do not use 95% alcohol that contains 5% water.
- Add the yellow food coloring to the water and not the alcohol; it is not alcohol soluble.

What is happening:

Molecules of ethyl alcohol actually pack together more closely with water molecules than with other alcohol molecules due to hydrogen bonding. The solvent molecules form a highly-laced, 3-dimensional network held together by strong hydrogen bonds. Each alcohol molecule is able

to form as many as three hydrogen bonds with neighboring water or alcohol molecules. The result is an intricate lattice or network of molecules strongly attracted to one another, which is why there is less volume than expected.

Demo 4: Iodine in Various Solutions

Materials:

- Large test tube
- H₂O wash bottle
- Methylene chloride
- Iodine
- KI
- Spatula and tweezers
- 1% starch solution
- Disposable pipets
- 150 ml beaker (optional: for holding methylene chloride)
- Test tube rack

Procedure:

1. Place the test tube in the rack and add dl water.
2. Using the tweezers, drop in a crystal of iodine. The iodine will not dissolve.
3. Add methylene chloride to the test tube, stopper and mix. The iodine will extract into the methylene chloride (bottom) layer, producing a dark pink color.
4. Add some KI to the test tube with the spatula. The KI will dissolve in the water layer. Agitate the test tube to mix again. The I⁻ ions in the aqueous layer will react with the I₂ in the organic layer to form triiodide (I₃⁻) ions, which are soluble in water. The layers will separate and some of the I₃⁻ will be extracted into the water layer, creating an amber color.
5. Optional: Add starch solution to produce the dark blue iodine-starch complex.

What is happening:

Methylene chloride is non-polar while water is polar and thus these two liquids do not mix. Methylene chloride is more dense than water and is the bottom layer. Iodine is non-polar and thus dissolves in methylene chloride by dispersion forces (induced dipole/induced dipole). A small amount of iodine may dissolve in the water initially due to dipole/induced-dipole interactions producing a slight brown color.

Disposal: Dispose of methylene chloride/iodine mixture in appropriate chlorinated waste container.

Demo 5: Water, Ethanol, and potassium carbonate

Description: A mixture of ethanol and water is made immiscible by the addition of potassium carbonate.

Materials:

- Deionized water
- Test tubes
- Ethanol
- Bromothymol blue
- Solid K_2CO_3
- 1 M HCl

Procedure:

1. Prepare a large test tube with 10 mL ethanol, 10 mL water, a few drops of bromothymol blue indicator and one drop of 1 M HCl. The solution is homogeneous and yellow.
2. Add 3 g of K_2CO_3 to a second test tube and pour the solution from step 1 into this test tube. The test tube is sealed with a rubber stopper and mixed thoroughly with shaking. At this point the solution will become biphasic and the organic phase will be blue. Alternatively, this reaction can be scaled up in large graduated cylinders.

What is happening:

Water and ethanol are miscible due to their existing intermolecular forces, the strongest of those being hydrogen bonding. As an electrolyte (in this case K_2CO_3) is added to water, the solvation of the electrolyte makes water unavailable to hydrogen bond with ethanol. The solubility of ethanol decreases as a result of the lack of hydrogen bonding interactions with water. As a result, the organic dye which was initially yellow due to the acidic solution is absorbed into the organic phase with ethanol and becomes blue.

Disposal:

The resulting mixture should be flushed down the drain with plenty of water.