Teacher's Guide for "Will Olive Oil Float?"

Joanne Wittbrodt, Ph. D.
Wayne County Community College District
Detroit, MI

Concepts:

density
miscibility

Supplies:

rubbing alcohol (75% or greater isopropyl alcohol)
olive oil
water
clear, colorless container with a leak proof lid

Description:

Pour rubbing alcohol into the container and then add some olive oil. The oil will sink because rubbing alcohol and olive oil are immiscible and olive oil is denser than rubbing alcohol. Add water to the mixture. Water is miscible with rubbing alcohol and is denser than both rubbing alcohol and olive oil. As the water mixes with the rubbing alcohol, the density of the water/alcohol layer increases and eventually exceeds the density of the olive oil. This causes the layers in the container to invert and the olive oil to float.

Notes:

The density of rubbing alcohol depends on how much water has been mixed with the isopropyl alcohol. The rubbing alcohol should be 75% or greater isopropyl alcohol to ensure that its density will be less than that of the olive oil. Practice the demonstration ahead of time with your actual demonstration materials so that you are familiar with the behavior of the mixtures.

Material	**Density (g/mL)**
isopropyl alcohol	0.785
olive oil	0.80 - 0.92
water	1.0

Safety and Disposal:

Isopropyl alcohol is volatile and flammable. Use with adequate ventilation and avoid ignition sources. Use the smallest about of material needed to provide adequate visibility for the audience. Wear safety goggles. At the end of the demonstration, label the sealed

container as “Hazardous Waste: Isopropyl alcohol and olive oil mixture”. The mixture can then be disposed of through the chemical waste management system at your institution, or for small quantities, by diluting the mixture with water and washing it down the drain with plenty of water. Be sure to run the water long enough to force all of the mixture out of the drain trap. If isopropyl alcohol is allowed to sit in the drain, flammable vapors may build up near the sink.

Performance of the Demonstration in the Classroom:

There are many ways to approach this demonstration. Practice ahead of time to develop your own style. Here is one possible scenario.

Pour some rubbing alcohol into the demonstration container and seal the lid. Place the demonstration container, a bottle of olive oil and the original rubbing alcohol container in an opaque box to prevent the audience from seeing the items before you begin.

Bring a bottle of drinking water but do not put it in the box with the demonstration supplies. Set the bottle of water off to the side as though it is your drinking water and not part of the demonstration.

Take the demonstration container out of the box and place it on the table. Do not remove the lid. Then hold up the bottle of olive oil and ask, “Does oil float or sink?” Wait for the audience to respond. Encourage as many responses as possible. Don’t answer any questions from the audience. If anyone asks what is in the container, respond by asking “Float or Sink? And why?” This will usually lead the audience to assume that you are talking about oil and water.

After the audience has responded, open the olive oil and the demonstration container; hold them up (but below your eye level) and pour some oil into the alcohol. The oil will sink. Close the container and the bottle of olive oil.

Ask, “Did the oil float or sink?” Sometimes, one or more audience members will insist that the oil is floating because that is what it is supposed to do. In this case, ask them to look carefully and then explain the difference between what “should” happen and what “did” happen.

Then, without saying what is in the container, ask, “What’s more dense?”

If the first response is “Oil”, then ask “Is that what you expected?” Encourage some discussion but don’t say what is in the container.

If the first response is “Water”, then ask, “Where is the water, top or bottom?” Then repeat the question, “What’s more dense?” until the audience agrees that, in the container, the oil has a higher density.

Add water to the container. The water will mix with the upper layer of alcohol and will increase its density causing the two layers to trade places.

If the water is poured quickly, the container kept still, and a large oil layer is present, it is sometimes possible to create three layers with the water on the bottom. Gentle mixing will cause the water and alcohol layers to combine at the bottom.
It is also possible to add the water slowly and stop when the water-alcohol mixture has the same density as the olive oil. In this case, the two phases form globular regions that seem to float inside each other. Adding a little more water will cause a clear separation into two layers.

Possible discussion topics, questions, activities:

- Describe what happened.
  - During laboratory experiments, some students have difficulty making accurate written observations. Discussion of what was observed can help students learn how much detail is needed for a compete description.

- What can be deduced about the original contents of the demonstration container?
  - Because the water causes a change, the original clear colorless liquid was not water.
  - After this discussion, inform the audience that the original liquid in the container was rubbing alcohol.

- Arrange the following in order of increasing density: olive oil, rubbing alcohol, water.
  - Rubbing alcohol, olive oil, water.

- Look up the densities of isopropyl alcohol and water (in a handbook, textbook or online)

- Calculate the density of the olive oil from the nutrition information
  - Look at the serving size information
  - 1 tablespoon = 15 mL

- What happened to the density of the alcohol layer as water was added?

- Classify the following pairs as miscible or immiscible
  - Isopropyl alcohol and olive oil
    - immiscible
  - Water and olive oil
    - immiscible
  - Isopropyl alcohol and water
    - miscible