

SEVEN-LAYER DENSITY COLUMN

Anyone can stack blocks, boxes, or books, but only those with a steady hand and a little understanding of chemistry can stack liquids. What if you could stack seven different liquids in seven different layers? Think of it as a science burrito.

WHAT YOU NEED

Light corn syrup

Water

Vegetable oil

Dawn dish soap (blue)

Rubbing alcohol

Lamp oil (select a cool color like red, available at a department store)

Honey

Glass cylinder

Food coloring

Food baster

Seven plastic cups

Scale (optional)

LET'S TRY IT!

1. Measure 8 ounces of each type of liquid into the seven plastic cups. Depending on the size of the glass cylinder, you might need more or less of each liquid—8 ounces is just a good starting point. You may want to color the corn syrup and the rubbing alcohol with a few drops of food coloring to create a more dramatic effect in your column. Here is the order of layers starting from the bottom and working your way to the top:

Honey
Corn syrup
Dish soap
Water
Vegetable oil
Rubbing alcohol
Lamp oil

2. Start your column by pouring the honey into the cylinder. It is very important to pour the liquids carefully into the center of the cylinder. Make sure the honey does not touch the sides of the cylinder while you are pouring. It's important to let each layer settle before adding the next one. Take your time and pour slowly and carefully.
3. The next layer is corn syrup. Again, try not to let the corn syrup touch the sides of the container as you're pouring. The key is to pour slowly and evenly.
4. Repeat the same procedure with the dish soap. Pour the soap directly into the middle of the layer of corn syrup . . . and take your time pouring!
5. Stop for just a second to enjoy your success. You're almost halfway to your goal of stacking seven layers of liquid. The next liquid is water, and you'll need to use the food baster—it's like a giant medicine dropper for food. From this point forward, it's okay to let the liquids touch the sides of the cylinder. In fact, it's a must! Dip the tip of the food baster in the cup of water, squeeze the bulb, and draw up some water. Rest the tip of the food baster on the inside wall of the cylinder and slowly squeeze the bulb. Let the water slowly trickle down the glass to create the next layer. Take your time!

**WARNING!
IMPORTANT
SAFETY RULES**

Lamp oil is a flammable liquid and must be handled with care. Adult supervision is required. Need I remind you to never light your Seven-Layer Density Column on fire? Just don't do it.



6. You'll use the food baster once again for the next layer—vegetable oil. Use the inside wall of the cylinder to let the vegetable oil slowly trickle down and form the next layer.
7. Wash the food baster with some soap and water in the sink before moving on to the rubbing alcohol. If you have not already colored the rubbing alcohol, use a couple drops of food coloring to make sure this layer isn't confused with water. Use the food baster and the inside wall of the cylinder to add this next layer.
8. You're one layer away from success. Again, rinse the food baster in the sink before moving on to the lamp oil. Since lamp oil is flammable, you must do this last step away from any open flames. Use the food baster to draw up some lamp oil, which has a low surface tension and easily leaks out of the food baster. Keep your finger over the tip as you transport it over to the cylinder. By now you're a pro at this. Use the baster and the inside wall of the cylinder to slowly add the final liquid layer.
9. Take your much-deserved bow and accolades from the guests in the viewing stands (or your friends hanging out in the kitchen). You've made a seven-layer science burrito, so to speak.

TAKE IT FURTHER

If you want to create an even cooler science burrito, add the “meat and black olives.” In other words, select a few items from around the house (safety pin, key, staple,



peanut, raisin, chocolate chip, small rubber bouncy ball, ping pong ball, etc.—be creative!) and carefully drop each item individually into the center of the cylinder. Some items will stay on or near the top of the stack of liquids and other items will sink part or all of the way down to the bottom of the cylinder. Why the difference? The densities and masses of the objects you drop into the liquids vary. If the layer of liquid is more dense than the object itself, the object stays on top of that liquid. If the layer of liquid is less dense than the object, the object sinks through that layer until it meets a liquid layer that is dense enough to hold it up.

Here's something else you can do to illustrate the connection between weight (or mass) and density. Set up a scale and weigh each of the liquids from your column. Make sure that you weigh equal portions of each liquid. You should find that the weights of the liquids correspond to their level in the column. For example, the honey will weigh more than the corn syrup. By weighing these liquids, you will find that density and weight are closely related.

WHAT'S GOING ON HERE?

The science secret here is **density**. Density is a measure of how much mass is contained in a given unit volume (Density = Mass ÷ Volume). If mass is a measure of how much “stuff” there is in an object or liquid, density is a measure of how tightly that “stuff” is packed together.

Based on this density equation (Density = Mass ÷ Volume), if the weight (or mass) of something increases but the volume stays the same, the density has to go up. Likewise, if the mass decreases but the volume stays the same, the density has to go down. Lighter liquids (like water or rubbing alcohol) are less dense or have less “stuff” packed into them than heavier liquids (like honey or corn syrup).

Every liquid has a density number associated with it. Water, for example, has a density of 1.0 g/cm³ (grams per cubic centimeter—another way to say this is g/mL, which is grams per milliliter). Here are the densities of the liquids used in the column, as well as other common liquids:

MATERIAL	DENSITY (g/cm ³ or g/mL)
Rubbing alcohol	0.79
Lamp oil (refined kerosene)	0.81
Baby oil	0.83
Vegetable oil	0.92
Ice cube	0.92
Water	1.00
Milk	1.03
Dawn dish soap	1.06
Light corn syrup	1.33
Maple syrup	1.37
Honey	1.42

The numbers in the table are based on data from manufacturers of each item. Densities may vary from brand to brand. You'll notice that according to the number, rubbing alcohol should float on top of the lamp oil, but we know from our experiment that the lamp oil is the top layer. Chemically speaking, lamp oil is nothing more than refined kerosene with coloring and fragrance added. Does every brand of lamp oil exhibit the same characteristics? Sounds like the foundation of a great science fair project.

So, the next time you're enjoying a glass of iced tea, you'll know why those ice cubes float. That's right . . . it's all about density.



Lamp Oil

Rubbing Alcohol

Vegi Oil

Water

Dawn Dish Soap

Karo Syrup

Honey

