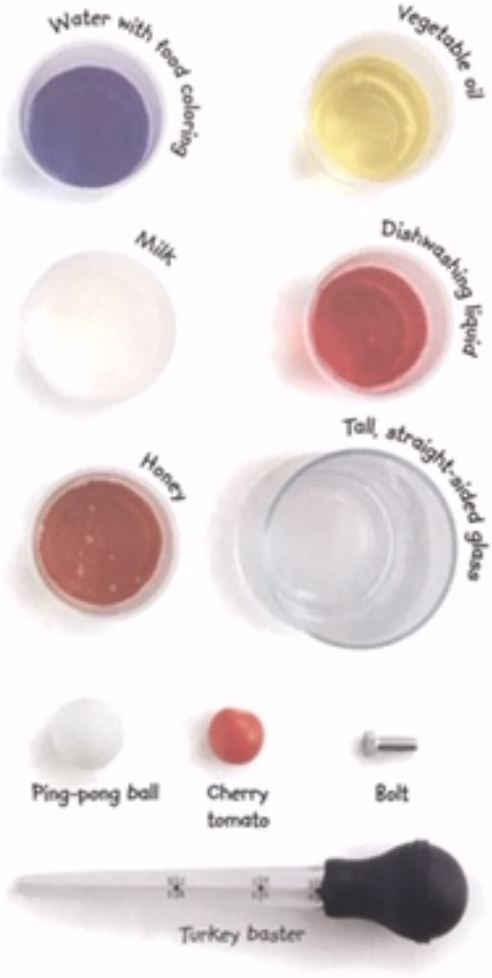
HOW TO MAKE A DENSITY TOWER

You'll need a steady hand to build this tower in neat layers. Most of the liquids are "water-based," meaning they are composed of water but with other substances dissolved in it. The following instructions show you how to make the layers using a turkey baster, but it's fine just to pour the liquids over the back of a spoon. After adding each liquid, remember to wash the baster or spoon before going on to the next layer. Don't stir the tower or these liquids will get mixed up.

Time
15 minutes

Difficulty
Medium

WHAT YOU NEED



1 The first layer of your tower is honey. This is the densest of the liquids. Carefully pour it in until it reaches about ¾in (2cm) up the glass. Honey is water with many other substances, mostly sugars, dissolved in it.

2 Next, put in the milk. Draw it up with the turkey baster and gently pour it against the side of the glass. It will settle on top of the honey. Milk is water with proteins, sugars, and tiny globules of oil.

For a stunning density tower, add each liquid slowly and carefully.

3 Make this layer just as you did in step 2. Draw up the dishwashing liquid with the baster and trickle it in slowly against the side of the glass. Dishwashing liquid is water with large detergent molecules dissolved in it.

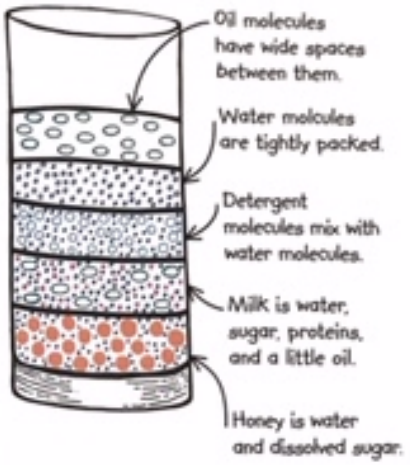
4 You're now ready to add the fourth layer, which is water. You can make this any color you like by adding a few drops of food coloring. Remember to trickle the liquid slowly! Water molecules are very small and tightly packed.

5 Finally, add vegetable oil, although olive oil also works. Interestingly, if you had put the oil in first instead of last, it would still have risen to the top because it's the least dense liquid—but you would spoil your tower!

6 Now gently drop in small objects, like a bolt, tomato, and ping-pong ball. The bolt sinks to the bottom because it is denser than the honey. The tomato sinks until it meets the milk. What happens to the ping-pong ball?

HOW IT WORKS

Although water molecules crowd closely together, each one has low mass, so water's density is fairly low. When substances dissolve in water, their molecules sneak in between the water molecules, increasing the solution's density. Oil molecules are bigger and do not pack together so tightly, which means it has a low density.



REAL WORLD SCIENCE
OIL SPILL

Occasionally, tanker ships carrying oil accidentally spill their contents. This is bad for sea life, and an oil spill is difficult to clean up. What makes the task a bit easier is the fact that oil floats on water. The oil can be scooped up out of the water or sprayed with detergents, which helps to dissolve it.

LIQUID DENSITIES

SCIENCE CHALLENGE 05

Designed by Ben,
Design engineer at Dyson

The brief

Layer different liquids in a tube and discover how and why they settle in a certain order.

The method

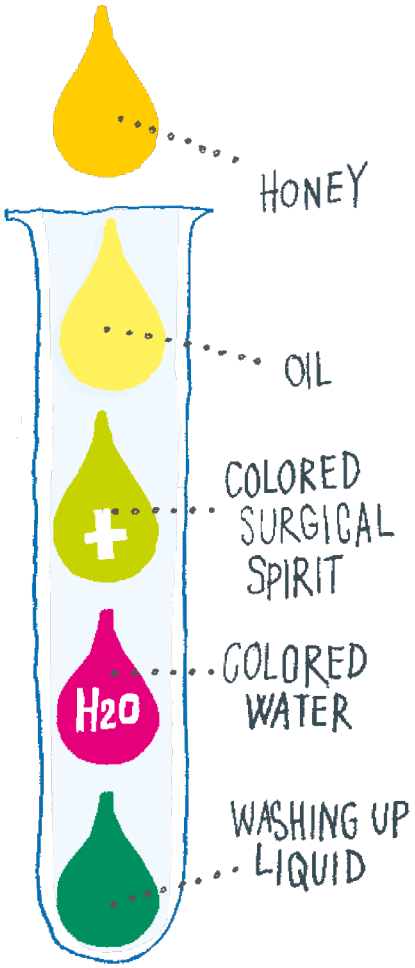
1. Start by adding food coloring to the rubbing alcohol and to the water – using a different shade for each. This will allow you to identify each liquid.
2. Measure out equal quantities of each liquid. Add them to the tube, one by one.

Top tip

Try weighing each liquid before you add it and predict which order the liquids will settle in. The layers may be a little mixed at first. Allow them to settle for a moment and watch the layers start to define.

Materials

- A test tube
- Honey
- Oil
- Rubbing alcohol
- Water
- Dish soaph
- Two shades of food coloring



How does it work?

Different liquids have different densities and therefore, different weights. The heaviest liquids will sink, the lighter liquids will rise to the top. Density is a comparison between an object's mass and volume. Remember the equation:

$$\text{DENSITY} = \frac{\text{MASS}}{\text{VOLUME}}$$

Based on this, if the weight – or mass – of something increases but the volume stays the same, the density has to go up. Lighter liquids, like water, are less dense than heavy liquids, like honey, and so float on top of the more dense layers.