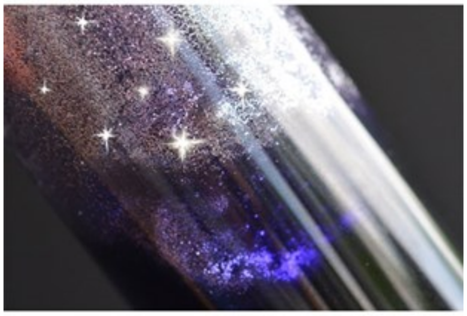
Anti-Gravity Galaxy in a Bottle

(source: https://onelittleproject.com/galaxy-in-a-bottle/2/)



Materials

- Plastic Water Bottle
- Baby Oil
- Water
- Purple and Blue Liquid Food Coloring
- Silver Glitter

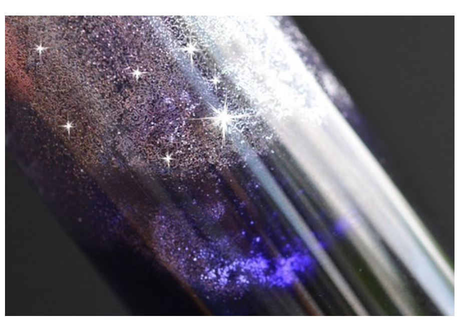
Instructions

1. Fill the bottle half full with baby oil.
2. Add silver glitter on top of the baby oil (About ½ teaspoon of glitter)
3. Add enough water to a measuring cup to fill the rest of the bottle, then add approximately 8 drops of purple food Coloring and 5 drops of blue food Coloring. The more food Coloring you add, the more opaque your galaxy will be.
4. Mix the water and pour it into the bottle, leaving about ¾" of air space in the mouth section of the bottle.

You need to have just a little bit of air in there. It makes it easier to shake it all together if there are some air bubbles in there to help with the mixing.

Screw the lid back onto the bottle. You can seal it closed with tape or glue if you like.

Shake the bottle vigorously and watch the glitter move up as it settles!



Oil and water don't mix – they are described as 'immiscible'. Crude oil floats on the sea after a spill from a tanker. Motor oil shows up as a sheen on puddles in the road. Olive oil separates out in salad dressing. But why don't they mix?

(sources :http://webcache.googleusercontent.com/search?q=cache:http://www.scienceprojectideas.co.uk/why-oil-water-dont-mix.html and https://www.stevespanglerscience.com/lab/experiments/oil-and-water/)

Density is basically how much "stuff" is packed into a particular volume. It's a comparison between an object's mass and its volume. Remember the all-important equation: density = mass ÷ volume. Based on this equation, if the weight (or mass) of something increases but the volume stays the same, then density goes up. Likewise, if the mass decreases but the volume stays the same, then density goes down. Lighter liquids (like water or vegetable oil) are less dense than heavier liquids (like honey or corn syrup) so they float on top of the heavier liquids. The same amount of two different liquids you used in the container will have different densities because they have different masses. The liquids that weigh more (a higher density) will sink below the liquids that weigh less (a lower density).

What is Oil?

Oil is a slippery liquid that burns (is combustible) and is not soluble in water. Oil is used as a fuel (petrol is made from oil, and oil is used in some houses for heating) and to make things move easily (it is a lubricant).

Oil can come from deep in the earth, or from plant or animal sources. Oil can also be made from chemicals (synthesised).

Why Don't Oil and Water Mix?

Unlike many other substances such as fruit juice, food dyes or even sugar and salt, oils do not mix with water. The reason is related to the properties of oil and water. Water molecules are made up of one oxygen atom and two hydrogen atoms. In addition to having this very simple structure, water molecules are polar, which means there is an uneven distribution of charge across the water molecule. Water has a partial negative charge from its oxygen atom and partial positive charges on its hydrogen atoms. This polarity allows water molecules to form strong hydrogen bonds with each other, between the negatively charged oxygen atom on one water molecule and the positively charged hydrogen atoms of another. Other molecules such as salts and sugars are able to dissolve in water because of its polarity as well. The charges at either end of the water molecule help break up the chemical structures of other molecules.

Oils, by contrast, are nonpolar, and as a result they're not attracted to the polarity of water molecules. In fact, oils are hydrophobic, or "water fearing." Instead of being attracted to water molecules, oil molecules are repelled by them. As a result, when you add oil to a cup of water the two don't mix with each other. Because oil is less dense than water, it will always float on top of water, creating a surface layer of oil. You might have seen this on streets after a heavy rain—some water puddles will have a coating of oil floating on them.

Mix some food colouring into some water in a jar and pour a bit of vegetable oil in. Give it a good shake and leave it for a moment. At first it might look like it has mixed, and then small droplets of oil form, and join with other droplets to make larger and larger drops, until the oil settles on the top of the water.

Water molecules are polar – they have a small positive charge at one end and a small negative charge at the other end, and they stick to each other. Oil molecules are non-polar – they have no charge. Because of this, oil molecules are more attracted to each other than to water molecules, and water molecules are more attracted to each other than to oil molecules.

Oil and water can be forced to mix together by adding an emulsifier (see 'Making an Emulsion'). This creates a stable mixture of water with droplets of oil spread through it, or oil with droplets of water spread through it, that does not settle out.

Why Does Oil Float?

Make a home-made lava lamp by filling a jar two-thirds full of water and put in some food colouring. Add some cooking oil. The oil will float on top of the water. Shake some salt onto the oil – it will form a blob and sink to the bottom. Once the salt dissolves, the oil will float back up to the top. If the oil doesn't sink, sprinkle on a bit more salt.

The oil floats on top of the water because it is less dense (a spoonful of oil weighs less than a spoonful of water). The salt is denser than the water – it weighs the oil down and makes it sink. Once the salt dissolves in the water, the oil floats back up to the top of the water.

Make a glitter globe by filling a jar one-quarter full of surgical spirit, and then almost filling the jar with cooking oil. Drop in a few sequins and some glitter, or other small shiny things. Fill the jar right up to the brim with oil, and screw the lid on tightly. Shake the jar. The oil and alcohol will mix together and then separate, and the glitter and sequins will sparkle as they move around in the mixture.

The alcohol floats on top of the oil because it is less dense (a spoonful of alcohol weighs less than a spoonful of oil). Like water, alcohol is a polar molecule so does not mix with oil.

The Practical Side

Having an oily coat or oily feathers helps animals that live in rivers or the sea keep warm in cold water, because the oil keeps the water away from their skin.

Oil and water not mixing also means that crude oil spills from tankers stay on the surface of the sea. This makes the oil accessible to remove, but it also means that sea animals and birds get caught up in the oil, which weighs down their feathers and fur and is poisonous if they swallow it when they are trying to clean themselves.

Another Experiment to Try

In this activity we will test the power of surfactants to help us mix oil and water. The surfactant we will use is dish detergent, which helps break up the surface tension between oil and water because it is amphiphilic: partly polar and partly nonpolar. As a result, detergents can bind to both water and oil molecules. We'll see the results of this property in this activity!

Materials

- 2 clear plastic water bottles with lids
- 2 cups of water
- One-half cup of oil (olive, cooking or vegetable oils will all work)
- Liquid dishwashing soap
- Clock or timer
- Permanent marker
- Measuring cup
- Measuring spoon
- Food coloring (optional)

Preparation

- Remove any labels from your water bottles.
- Use your marker to label the bottles: Label the first "Oil+Water" and the second "Oil+Water+Soap." Write the labels as close to the tops of the bottles as possible.
- Pour one cup of water into each bottle.

Procedure

- Carefully measure and pour one-quarter cup of oil into the bottle labeled Oil+Water. Allow the bottle to sit on a countertop or flat surface while you observe the water and oil. *Does the oil sink to the bottom of the bottle, sit on top of the water or mix with it?*
- Repeat this step, adding one-quarter cup oil to the bottle labeled Oil+Water+Soap. *Does the oil sink to the bottom, sit on top of the water or mix with it?*
- Carefully add three tablespoons of dish soap to the bottle labeled Oil+Water+Soap. Try not to shake the bottle as you add the dish soap.
- Make sure the bottle caps are screwed on tightly to each bottle.
- Holding a bottle in each hand, vigorously shake the bottles for 20 seconds.
- Set the bottles down on a flat surface with plenty of light.
- Note the time on your clock or set a timer for 10 minutes.
- Observe the contents of each bottle. Hold them up to a light one at time so you can clearly see what is happening inside the bottle. *Did anything change when you shook the bottles? Do the*

mixtures look the same in the both? If not, what is different between them? How would you explain the differences that you observe?

- After 10 minutes have passed look at the contents of the bottles and note the changes. *What does the oil and water look like in each bottle? Has the oil mixed with the water, sink to the bottom or rise to the top?*
- **Extra:** Add food coloring to the water to get a lava lamp effect
- **Extra:** Test other types of soap, such as toothpaste, hand soap and shampoo by mixing them with oil and water.

Observations and results

In this activity you combined oil and water then observed how adding dish detergent changed the properties of this mixture. First you should have noticed that when you added the oil to the water they did not mix together. Instead the oil created a layer on the surface of the water. This is because oil is less dense than water and therefore it floats to the surface. When you shook the Oil+Water bottle you might have noticed the oil broke up into tiny beads. These beads, however, did not mix with the water. After you let the Oil+Water bottle sit for 10 minutes you should have observed the oil and water starting separating again almost immediately, and after another 10 minutes there was once again two distinct layers in your bottle.

In contrast you should have found shaking the Oil+Water+Soap bottle resulted in a lot of foam, but instead of immediately starting to separate, the mixture was a cloudy, yellow color. Eventually the oil and water should have separated into two layers again, but these layers should have appeared less distinct and cloudier than the layers in your Oil+Water bottle.

The difference between the two bottles results from adding dish detergent to the Oil+Water+Soap bottle. The detergent molecules can form bonds with both water and oil molecules. Therefore, although the oil and water aren't technically mixing with each other, the dish detergent molecules are acting as a bridge between oil and water molecules. As a result, the oil and water molecules aren't clearly separated in the bottle. Instead, you see a cloudy mixture, resulting from the oil, soap and water chains you've created by adding dish detergent.