Two-sided soap molecules create soap bubbles

Question: Why does soap make bubbles?

Answer: Try an experiment: Pour some cooking oil into a bottle and then add some water. Notice how the liquids won't mix. Even if you close the bottle and shake it, as soon as you stop shaking the oil floats to the top of the water. In other words, they don't like to mix.

Why don't the oil and water mix? Oil and water are made of different types of molecules that are far too small to be seen. When you poured the molecules of water into the bottle, they settled to the bottom as a liquid. The molecules didn't fly apart and fill the entire bottle because water molecules stick together. Likewise, the oil molecules also stick together. Different molecules have different tendencies to stick together. The oil and water did not mix. This shows that oil molecules do not like to stick to water molecules.

Soap will mix with both water and with oil. Why? The soap molecule has two different ends: One end likes to stick to water molecules, while the other end likes to stick to oil molecules. The oily end also likes to stick to air molecules.

If you mix water, soap and air, the soap molecules line up side-by-side to make a layer. One side of this layer has the oily, air-liking ends sticking out and the other side is covered with the water-liking ends. The water molecules stick to the water side and the air to the other side. If you have a lot of air and a little water, which is what happens if you blow a lot of air into a soap-water mixture, then you wind up with a sandwich of three layers: Soap with the oily ends facing the air on either side and water in between. This is just the wall of a soap bubble. So the reason soap, water and air makes bubbles is because air and water molecules don't like to stick together but will stick to different ends of soap molecules.

ASK A SCIENTIST

Today's question was answered by scientist Sol M. Gruner

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Today's question was asked by student Henri Schuette

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Ask A Scientist appears each Thursday on the Health & Science page. Questions are answered by local or regional researchers through the Cornell Center for Materials Research (CCMR) Educational Programs Office. If you have a question, write to Ask A Scientist, c/o The Ithaca Journal, 123 W. State St., Ithaca, NY, 14850, or e-mail it to tfleisch@ithaca.gannett.com. You can also check out the Ask A Scientist Web site at www.ccmr.cornell.edu/ask.

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Question Metadata

Topics	Physics
Hits	401

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Ask A Scientist!

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Q **Why does soap make bubbles?**

Ask your own question!

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Scientists try to understand the way molecules behave by making models. Let's model molecules by little squares of colored paper. Cut up white paper into 15 small white squares, an inch on a side. Let's say each white square is model of a water molecule. Now cut up 15 red squares, and inch wide. Suppose each of these is a model of an oil molecule. Now draw a rectangle 5 inches wide and 9 inches tall on a side on a big piece of paper -- this will be the model of your bottle. Try filling the bottle from the bottom up with your model molecules, without leaving spaces, according to the following rules: Water molecules like to stick to water molecules, so each white square should touch as many white squares as possible. Oil sticks to oil, so each red square should touch as many red squares as possible. Oil doesn't like to stick to water, so red squares should touch white squares as little as possible. You'll find that an arrangement that best fits these rules is to first fill the bottle from the bottom up with white squares (water is heavier than oil, so it sinks to the bottom) and then to continue filling with red squares.

Now try another experiment. Mix a drop of liquid dishwashing soap into a glass of water and stir with a spoon. The drop of soap disappears. This shows that the soap molecules stick to water molecules. Now mix a drop of liquid dishwashing soap into a glass of oil and stir with a spoon. The soap again disappears, showing that the soap molecules also stick to the oil molecules.

Stop and think about this. Water will mix with water, and oil with oil, but water will not mix with oil. Clearly, soap mixes with soap. Yet the soap will mix with both oil and water. How can this be?

As we said, suppose the soap molecules have two different ends: One end likes to stick to water and the other end likes to stick to oil. We can add this to our model to see what happens. Cut up 10 more white squares, each an inch on a side. Color one half of each of these squares red. These are models of soap molecules. Our rules are red sides likes to stick to red and white likes to stick to white, but red doesn't like to stick to white.

First of all can, you fill the bottom of the bottle with soap? Yes, just put a layer of soap models in with white sides down. Then add another layer on top with red sides down. So far, so good. If you had more soap molecule models you could just go on adding alternating layers like this until the bottle is full.

Can you now add water to the soap in the model bottle? Sure. Just put a layer of white soap molecules between the opposed white ends of two layers of soap. This triple-decker sandwich - two layers of soap molecules with water molecules in between is the arrangement of molecules that makes up the wall of a soap bubble. Although you probably haven't seen it, it is possible to make a kind of bubble without air by mixing a little bit of soap and water with a lot of oil. Normally, however, we use a bit of water and soap and a lot of air.