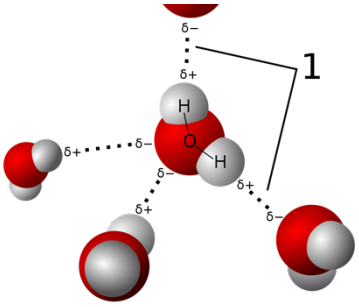
Science of Bubbles

Bubble

A soap bubble is like a water sandwich. It's two layers of soap (the bread) with a layer of water in between (the filling)

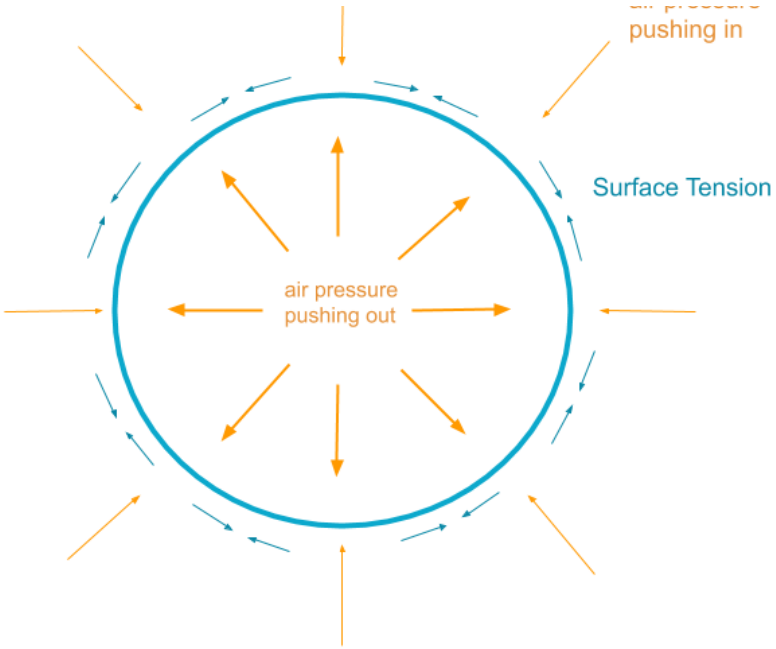


Water molecules are made up of an oxygen molecule (O) and two hydrogen molecules (H). Hydrogen is slightly positively charged and oxygen is slightly negatively charged.

Because of this, water molecules want to stick together, creating *surface tension*. Surface tension is the reason why bubbles form perfect spheres. Bubbles minimize surface area as much as possible, making the sphere the best possible shape.

Three different forces act together to make bubbles into perfect spheres.

1) Air pressure inside the bubble pushing out
2) Air pressure outside the bubble pushing in
3) Surface tension of the soap bubble



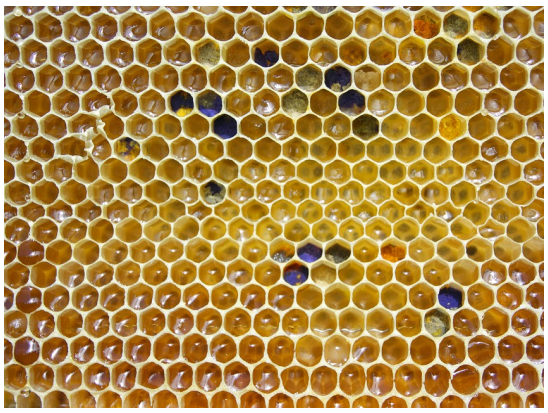
Try using different shaped bubble wands. Can you make a bubble that's not round?

What happens if you blow 2 bubbles onto the table side by side so they attach together?

What about 3 bubbles?

Because of surface tension, bubbles naturally want to hold the same amount of air with the least possible surface area. This forms a straight line between 2 bubbles, or a 120° angle between 3 or more bubbles, forming *perfect hexagons*!

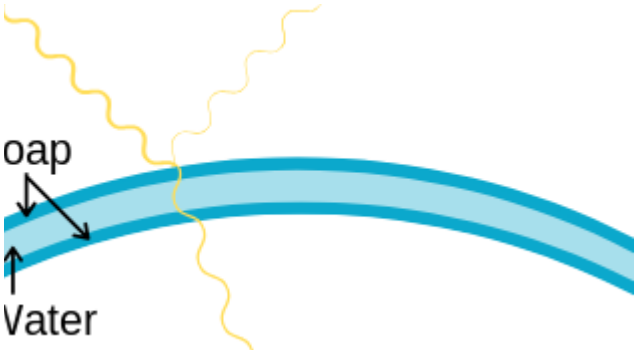
Can you think of anything else in nature that forms hexagons?

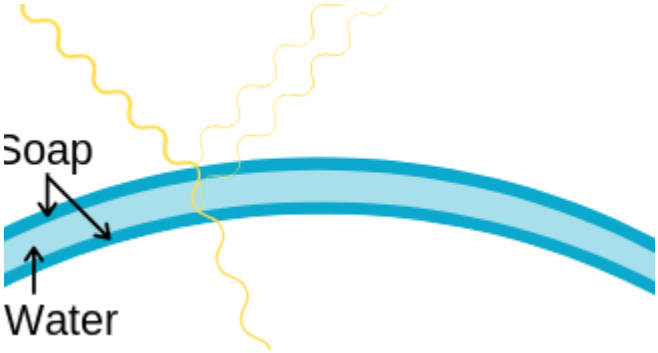


Why are bubbles so colourful?

The colourful patterns we see on the surface of a bubble are called eddies. But what causes these eddies to form?

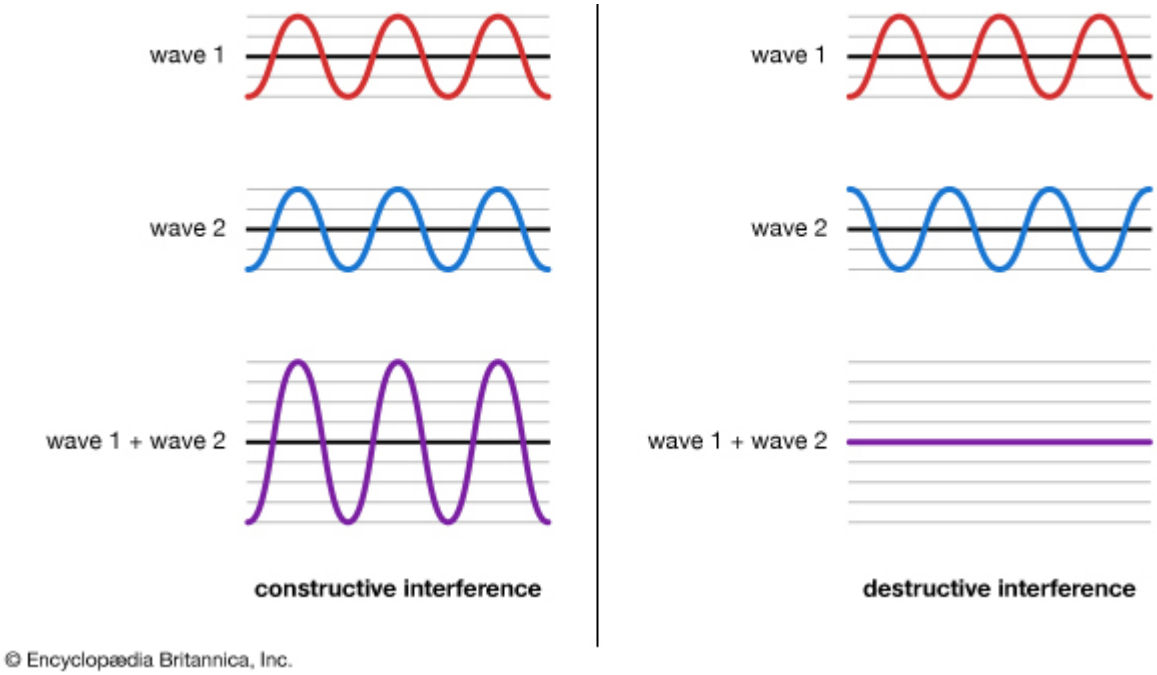
When light shines toward the outer surface of the bubble, most of the light is transmitted (goes through) and a small amount of light is reflected. Some of the light will reflect off the second soap layer as well.





These waves can interfere with each other constructively (left) and be amplified or destructively (right) and get cancelled out.

Do you think the waves above would interfere constructively or destructively?



Depending on the thickness of the water bubble, different wavelengths of light will be amplified or cancelled out. The thickness of the water layer is constantly changing throughout the bubble, which is why we see the colours continually changing!

Part of the reason why the thickness changes and the colours swirl is described by the Marangoni effect.

Marangoni effect – the tendency for fluids move from areas of low surface tension to areas of high surface tension.

Soap is a surfactant and it breaks the surface tension. This means that the water molecules near the soap are no longer as attracted to each other. Water molecules from farther from the soap then pull on molecules near the soap.

We can see the Marangoni effect in action with a simple science experiment!

1) Fill a shallow dish with milk
2) Add a few drops of food colouring near the centre
3) Add a small drop of soap to the centre of the dish and watch as the colours "run away" from the soap!

The soap breaks the surface tension in the middle of the dish. The milk near the edges of the dish then pull in the milk from the middle.

Activities and Interactions!

Blow a bubble, get a few laughs. Then talk about what makes a bubble.

A bubble is just air wrapped in soap film. Soap film is made from soap and water (or other liquid). The outside and inside surfaces of a bubble consist of soap molecules. A thin layer of water lies between the two layers of soap molecules, sort of like a water sandwich with soap molecules for bread. They work together to hold air inside.

Create a bubble that stretches out using the large wands (we will have 3). Whoosh it through the air so that the bubble follows and grows behind it. Then, with great drama, let the bubble go. Give the onlookers a chance to note what happens to it before it pops.

Why is a bubble round? Bubbles can stretch and become all kinds of crazy looking shapes. But if you seal a bubble by flipping it off your wand, the tension in the bubble skin shrinks to the smallest possible shape for the volume of air it contains. That's why even if it had a goofy shape before you sealed it, once sealed shut, the bubble will shrink into a sphere shape. Compared to any other shape, a sphere has the smallest surface area for the amount of volume.

Blow several bubbles and have the onlookers blow and fan them to keep them from landing. The objective here is to watch them pop without obvious interference. And it's a bit of fun for everyone.

Why do bubbles pop? Other than being poked or landing on something sharp, bubbles pop when the water between the soap film surfaces evaporates. To note, when it's cold, those molecules take longer to leave. If you blow a bubble on a calm winter day, a bubble can even freeze and last for several minutes before it wisps away.
Also, the colder the outside temperature is, the higher a bubble might fly. That's because the warm air from your breath is lighter than cold air.

Blow more bubbles and ask a few people to study them close-up. What do they see? Is a bubble really transparent, or do bubbles have colors? Can they see their faces in the bubbles?

A bubble gets its color from light waves reflecting between the soap film's outer and inner surfaces. The distance between the layers gets smaller as the water evaporates, making the colors change. Bubbles can also reflect what's around them, like the faces peering at them.

Blow several bubbles with a straw so that you have a three of them stuck together – this might take practice!

Why do bubbles stick together? Since a bubble tends to minimize its surface area, bubbles will join together to share one common wall. Three bubbles will meet at the center, always at an angle of 120 degrees.

This is not as easy to set up, but not that difficult and a very cool experiment: use two sheets of clear plastic that are about a half inch apart. You could put one sheet on a table and prop up the second with thin blocks. Soak the sheets in a bubble solution, place them, and then blow bubbles between them.

When bubbles are about the same size, they form perfect hexagons. Bees do the same thing when they build a beehive. Bees, like bubbles, are also very efficient with their spaces. They use the minimum amount of wax to create their spaces.

Set the lid of the bubble container on a table and fill it with bubble solution. Dip a straw into the container so it is moistened by the solution, and blow a bubble on the lid. Then draw out the straw. Magic! Next, dip the pointed ends of a pair of scissors in the solution. Poke them through the wall of your bubble. Let the kids try poking other stuff that has been moistened in the solution, even their fingers. You can then poke your straw back inside the bubble and blow another bubble. By now, you should be super awesome in their minds.

Why didn't the bubble pop? The bubble just wraps itself around anything that is wet, filling in the hole that would have been made.

Giant Pool Bubbles – Have a team mate or participant stand in the middle of the pool and pull the hula hoop up around them to trap them in a giant bubble!

The formula for awesome bubbles:

1 cup liquid dish soap like Joy or Dawn (not "ultra")
6 cups distilled water inside a clean container that has a lid
1 tablespoon glycerin **OR** 1/4 cup light corn syrup

Pour the dish soap into the water and mix it without letting bubbles form (that's for later!). Put the glycerin or corn syrup into the mix and stir. You can use it right away, but some bubble-lovers recommend covering and letting the bubble mix sit overnight.