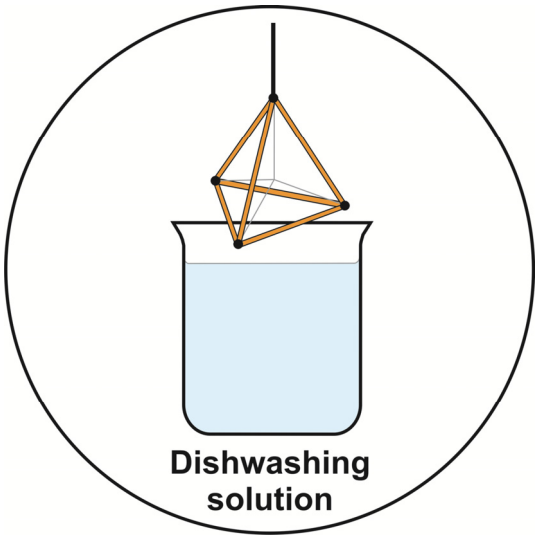
Optimal Bubble-ology



Equipment:

drinking straws
chenille stems (AKA pipe cleaners)
beaker (or small bucket, container or the like)

"Chemicals":

tap water
dishwashing liquid

Safety:

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Procedure:

Preparation: The drinking straws are cut so that one obtains six pieces of equal length. In order to form a tetrahedral frame, the straight pieces are connected at the corners by inserting short bent sections of chenille stems into the end of each straw. Finally, a chenille stem handle is attached to the frame. Subsequently, the beaker is filled with enough water so that the frame is entirely covered when it is dipped later. About two spoons of dish-washing liquid are added to the water and the two components are gently mixed. Too much froth on the surface of the solution should be avoided (the bubbly froth can be scooped away with a spoon as necessary).
Procedure: The tetrahedral frame is carefully dipped into the dishwashing liquid containing solution and then slowly lifted out of the solution.

Observation:

The soap film forms a series of plane surfaces, each of which begins at an edge of the tetrahedron and meets all the other surfaces at the center of the tetrahedron. Depending on the direction of light incidence, the soap films shimmer in different colors.

Explanation:

The soap film tends to minimize the surface energy by assuming the shape of least surface area possible taking into account the restrictions imposed by the framework. The intricate shape inside the tetrahedral frame represents this minimum area. Soap films are therefore physical examples of the complex mathematical problem of finding the minimal surface of a boundary with specified constraints known as Plateau's problem. The problem was raised by Joseph-Louis Lagrange in 1760 but named after the Belgian physicist Joseph Plateau who solved some special cases of the problem experimentally using soap films and wire frames.
Since the thickness of the soap film is comparable to the wavelength of light it gives rise to colorful interference patterns. This phenomenon is called iridescence.

Disposal:

The tetrahedral frame made from drinking straws and chenille stems can be disposed of with the household waste and the dishwashing solution can be flushed down the drain.