Can you drink through a 30 foot straw?

A laboratory experiment from the Little Shop of Physics at Colorado State University

Overview

Here's the answer: No.

Theory

And here's why: When you drink through a straw, it's not "suction" that pulls the liquid up the straw, it's the pressure of the atmosphere that pushes the liquid up the straw. The pressure of the atmosphere can only push the liquid up so high.

Try it and see! At sea level, with zero pressure at the top, atmospheric pressure can only push the water up the column by about 10.3 meters, or about 34 feet. So no one, no matter how strong, could drink through a 35 foot straw. In Colorado, the limit is even less. Atmospheric pressure is lower, so a 30 foot straw will do the trick.

Otto von Guericke's water barometer from 1654. Mercury makes a barometer of a much more manageable height!

Of course, atmospheric pressure varies. If you set up a column of water with a vacuum at the top, the height of the water column would vary with air pressure: Higher pressure would mean a greater height. If you monitored the height of the water column, you'd have a record of atmospheric pressure. What you'd have would be a barometer! Of course, you can get away with a much shorter barometer if you use a more dense liquid like mercury...

Necessary materials:

- One 25 foot piece of 3/8 inch clear plastic tubing
- One cup or bottle of a colorful, non-carbonated beverage
- One ladder or a set of stairs

The choice of liquid is key. It is important to have a non-carbonated beverage, because the bubbles from a carbonated beverage will break up the fluid column in the straw. Choose a colorful drink so that others can watch the liquid work its way up the straw. (Black coffee is a good choice. Heating the liquid gets rid of any residual dissolved gas, and it is dark and easy to see. The volunteer will in all likelihood never get to taste the liquid anyway.)

Doing the Experiment

This is a good class demonstration to do as an engagement activity. Students find it quite surprising, and it leads to a lot of good discussion about pressure, atmospheric pressure–and why it's possible to drink a beverage through a straw at all!

Find a good place to work where you can have a beverage set at a low level and the person drinking through the straw at a much greater height. An open set of stairs is great, but you may have to resort to using a ladder. Ideally, you will want to have a height between the bottom and the top of the straw of more than 15 feet, though more is better.

Have a volunteer hold the bottom of the straw in the container, and have another volunteer stand at the top of the stairs or the ladder and try to drink through the straw. The rest of the class can watch the progress. If the height is great enough, the person will not be able to drink through the straw, no matter how hard they try. We have never found anyone who can drink through a straw that is 20 feet between the top and the bottom, but most people can't do much more than 10 feet.

Summing Up

This is surprising and a nice challenge exercise for your class. People are convinced that they should be able to do this for, "It's just drinking through a straw!" but, they can't.

For More Information

CMMAP, the Center for Multi-Scale Modeling of Atmospheric Processes: http://cmmap.colostate.edu

Little Shop of Physics: http://littleshop.physics.colostate.edu