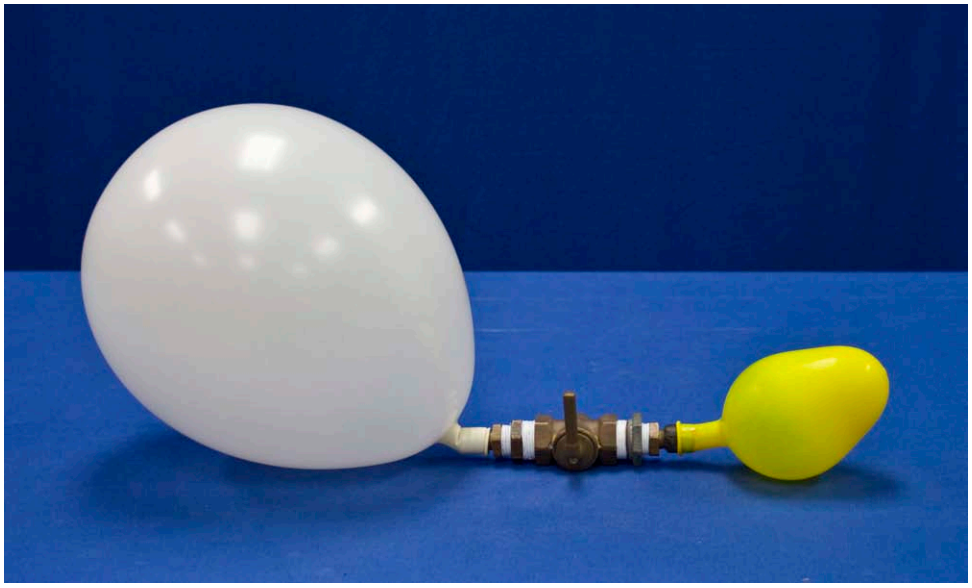
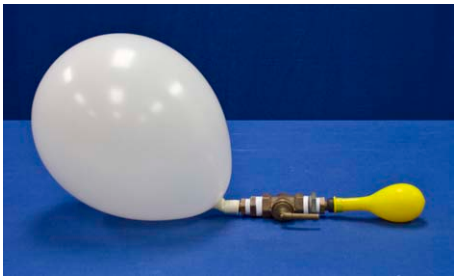
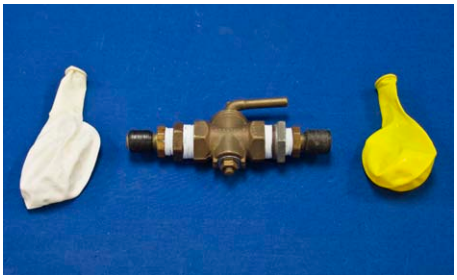
RUBBER BALLOONS 2A10.51

Fluid Mechanics | Surface Tension | Force of Surface Tension







Concept:

Here's a counter-intuitive demo that many physicists get wrong. When two similar balloons are inflated to different diameter and connected through a closed valve, what happens when the valve is then opened?

Answer: The smaller balloon becomes still smaller and the larger balloon larger.

The explanation is clear from Laplace's law:

$$\Delta P = \frac{2\gamma}{r}$$

Here ΔP = pressure difference between inside and outside the balloon, γ = surface tension of the rubber, and r = balloon radius. Thus, it requires a *greater* pressure difference to sustain a small balloon than it does a larger one. Thinking about when it is most difficult to inflate a balloon by mouth reminds us that it is most difficult when we begin blowing, when the balloon is smaller. A very interesting application is to the function of human lungs. If the surface tension were not also dependent on the varying *concentration of liquid surfactant* coating the lungs, the lungs would collapse (see http://hyperphysics.phy-astr.gsu.edu/hbase/ptens2.html).

Equipment:

- (2) Balloons
- Double Air Valve

Procedure:

1. Verify that the valve is in the closed position (as shown in the top-left picture).
2. Inflate each balloon to different diameters and place them on the end of each valve.
3. Open the valve to equalize the pressure between both balloons (as shown in the top-right picture).
4. Notice that air from the less inflated balloon moves to the more inflated balloon.