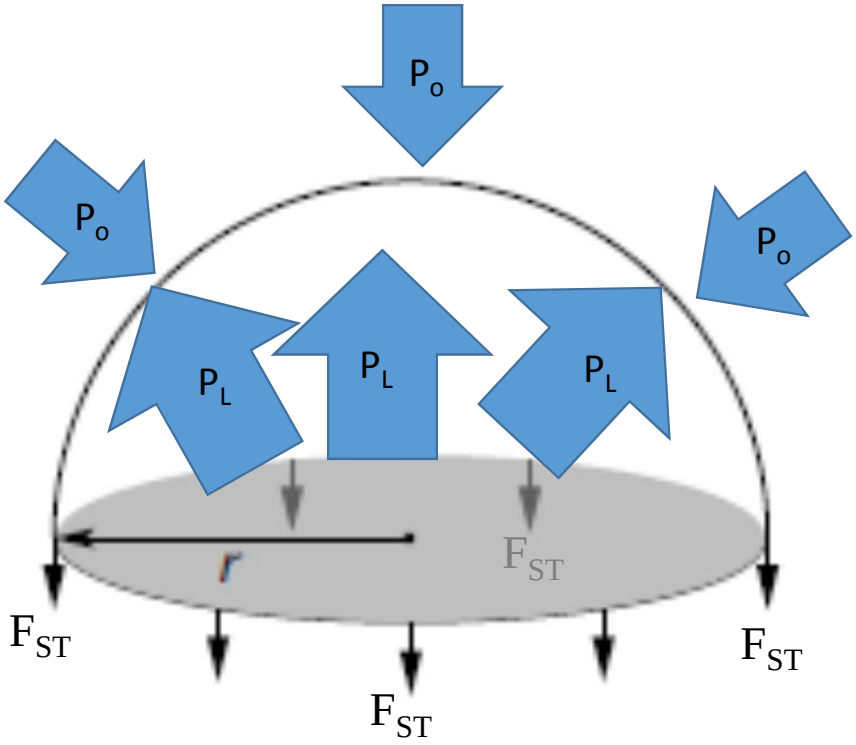
Excess pressure inside a spherical drop



$$Excess\ pressure\ = \Delta P = P_L - P_o$$

Consider a drop shown in the figure which is in equilibrium. The force due to the pressure difference between the inside and outside of the drop must be balanced by the force due to the surface tension. The force due to the surface tension is directed downwards as indicated by the arrows and is equal to the circumference of the drop times the surface tension ($F_{ST} = 2\pi r\gamma$). The force that balances the surface tension is due to the pressure difference between the inside and outside of the drop, which is directed outwards, perpendicular to the surface of the drop. The only unbalanced components of the forces due to the pressure difference are directed upwards, so must be equal to the shaded area in the figure times the pressure difference ($\pi r^2 \Delta P$). Thus

$$F_{Excess\ Pressure} = F_{ST}$$

$$\Delta P A = \gamma l$$

$$\Delta P \pi r^2 = \gamma 2\pi r$$

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

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

Detergents

Why the addition of detergent facilitates the removal of stain from the fabric.

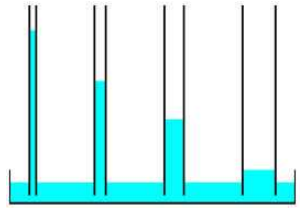
Water alone cannot penetrate through some of the pores to dissolve the dirt due to surface tension. Detergent reduces the surface tension making it easier for water to penetrate through these pores and dissolve dirt.

Gardening

Which soil can conserve moisture during the dry seasons.

Cultivated soil has lager air spaces and moisture cannot travel through

Small cracks allow capillary action to take place and water evaporates when it gets to the surface



Example

Example 6.8: Excess pressure in a drop of mercury.
Calculate the excess pressure inside a spherical drop of mercury of diameter 4.0 mm. (For mercury $\gamma = 0.465$ Nm^{-1})

I27 Calculate the excess pressure inside a raindrop which is 5.0 mm in diameter.

I28 (modified) If the excess pressure inside a drop of mercury is 473 Pa, what is the diameter of the drop (take the surface tension of mercury as $\gamma = 0.473$ Nm^{-1})

Prescribed tutorials under **Fluids at rest**
I2-I9, I11-I15, I17, I23-I24, I27-28