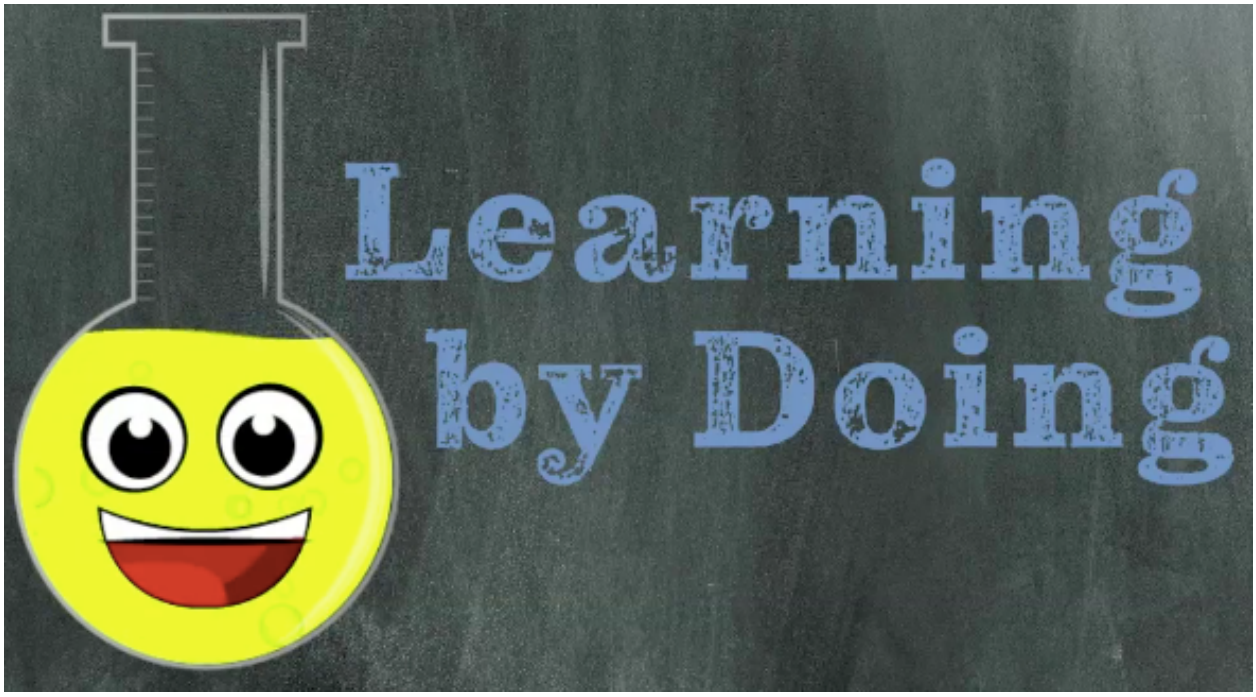

LEARNING MATERIALS
SURFACE TENSION

Surface tension is the force exerted upon the surface molecules of a liquid by the molecules beneath. Water is a liquid with high surface tension, which means that the molecules that make up water pull on each other with great strength. This property of water can be easily demonstrated by slowly adding one drop of water (with a medicine dropper or pipette) at a time to a penny placed on a table. The water will form a dome on top of the penny until one drop too many breaks those bonds and the water spills out over the sides.

In this experiment, the molecules of water at the surface of each bowlful were tugging on each other with greater strength than the molecules beneath. This is because molecules at the surface, not being completely surrounded by other water molecules (there is air above the surface), compensate by forming even tighter bonds with their neighbors, the molecules to the side and underneath. The stronger cohesion between water molecules at the surface allowed the pepper flakes to float on top. Similarly, it is the high surface tension of water that will support a paper clip, pin, needle or any other small object permitting it to float on top. Incidentally, this also how water strider bugs can walk on water without sinking and why water droplets form into little spheres.

The dishwashing liquid that we added to the second bowl was able to lower the surface tension of the water. By doing so, the surface tension of the area where the soapy finger was dipped dropped, but the more distant areas of peppered water, near the sides of the bowl, still had high surface tension, and so they pulled the peppered water over toward themselves. Evidently, the milk does not have the ability to lower the surface tension of the water, and so the pepper in that bowl did not move.

Surface tension is an important property of a liquid surface that manifests by it behaving as if it were a stretched elastic membrane. Many natural phenomena, like the shapes of water droplets, the cohesion between cells in our body is dictated by surface tension.

Questions for testing comprehension:

(1) What other kinds of liquids might work to move the pepper? Try the experiment with juice, toothpaste, Windex, and disinfectant gel. What do you observe?
(2) Why is soap so helpful in removing dirt, either from our skin or from our clothing?

Questions for deeper understanding:

(1) Why do water and other liquids have surface tension?
(2) What is the role of gravity in surface tension?

Further reading & materials:

(1) Surface Tension and all the contexts in which it is important:
    (a) https://www.youtube.com/watch?v=i2TguDlE680
    (b) https://www.youtube.com/watch?v=WsksFbFZeeU
(2) Surface Tension & Adhesion:
    (a) https://www.youtube.com/watch?v=pmagWO-kQ0M
    (b) https://www.youtube.com/watch?v=zMzqiAuOSz0
(3) Understanding properties of water:
    https://www.youtube.com/watch?v=3jwAGWky98c
(4) Additional cool effect – surface tension and the Marangoni Effect:
    https://www.youtube.com/watch?v=rq55eXGVvis