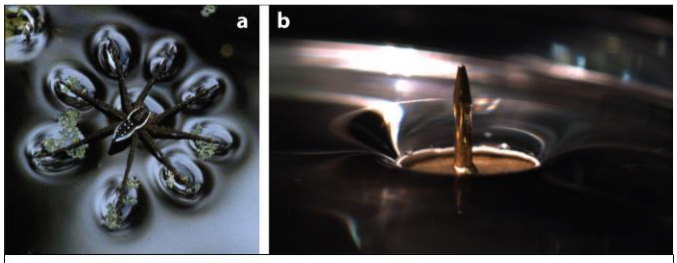
Lab 1C: Surface Tension

In this lab experiment, you will observe how an object with a density greater than water still sits on the water surface and compute how forces arising from surface tension allow this happen. Surface tension is due to unbalanced cohesive forces acting on liquid molecules at liquid-gas interfaces. Along liquid-gas-solid boundaries, the behavior depends on whether the liquid cohesive forces are greater than or less than the solid attractive forces. For example, water adheres to glass more readily than itself. Similarly, some objects with density greater than water will sit on the water surface because the strength of the cohesive forces at the surface.



a) Water spider *Dolomedes triton*; b) Drawing pin on water Vella (2015) ARFM

Learning outcomes:

- Identify the role of surface tension in floating objects

Part A: Floating a CD

Objective:

Float a CD (an ancient form of musical technology) on water to observe the effects of surface tension.

Procedure:

(1) Measure the mass, inner diameter, and outer diameter of the CD. Record these measurements in the table below
(2) Gently place the CD on the water surface such that it floats.
(3) Gradually add weights (pennies or paper clips) until it sinks.
(4) Dry the weights with a paper towel, weigh them, and record the mass of the weight added.
(5) Repeat the entire procedure to verify the values.

Mass of CD	Inner Diameter of CD	Outer Diameter of CD	Mass of Weight added

Questions and analysis:

(1) Using the 'book value' of surface tension at the water-air interface ($\sigma = 72.8 \times 10^{-3}$ N/m) and the perimeter of the CD, calculate the maximum mass that surface tension can support. (5 pts)

(2) How does the measured mass + mass of CD compare with the maximum calculated mass supported by surface tension alone? If your measured value is higher, what other force could support the extra weight? (5 pts)

Part B: Capillary Rise

Objective:

Watch a video on capillary rise and understand the relationship between diameter and capillary rise, h.

Procedure:

(1) Watch the video at the link: https://youtu.be/PP9mn-X9i2Q

Questions and analysis:

(1) Draw a force balance for capillary rise.

(2) Solve the force balance to determine an equation for capillary rise height, h, as a function of diameter, D, surface tension, σ, specific weight, γ, and contact angle from the vertical axes, θ.

(3) How does diameter relate to capillary rise? If you increase diameter of a tube, what happens to capillary rise height, h?