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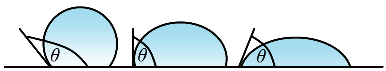
Dew on Equisetum fluviatile (water horsetail) by Luc Viatour www.lucnix.be

Nature's Raincoats

why bumpy surfaces keep the rain off

A tiny drop of water floating in the air will be spherical to minimise the energy of the boundary between the liquid (the water) and the gas (the air). When the drop lies on a surface it takes the shape of a sphere cut off by the surface.

To capable of wetting a surface, a liquid must be able to maintain contact with it through intermolecular interactions. Some surfaces, described as hydrophilic, are easy to wet. Droplets spread out on these surfaces. The contact angle θ is less than 90°. Other surfaces, known as hydrophobic, are more resistant to wetting. The droplets spread less on hydrophobic surfaces, with θ tending towards 180° on superhydrophobic surfaces.



Droplets on increasingly hydrophilic surfaces

No known material can be used to make a smooth surface with a superhydrophobic contact angle. Some plants overcome this restriction by covering their leaves with tiny bumps. This project looks at plants, like Nasturtium and Lady's Mantle, whose leaves are observed to be superhydrophobic. Water droplets on these plants are nearly spherical.

This is known as the Fakir Effect and it can convert hydrophobic surfaces into superhydrophic surfaces. It occurs because the tiny bumps on the surface mean that the boundary between raindrop and leaf becomes a composite boundary of water, leaf and air. The droplet balances on the spikes of the leaf surface trapping air beneath it.

In mathematics, wetting can be examined by looking at the surface tension (extra energy) at the boundaries between leaf and water, water and air, and air and leaf. The contact angles can be predicted using Young's Law and this in turn can be used to explain why the Fakir Effect occurs.

Wetting ***Hydrophilic*** ***Hydrophobic*** ***Superhydrophobic***

Fakir Effect ***Surface tension*** ***Young's Law***

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