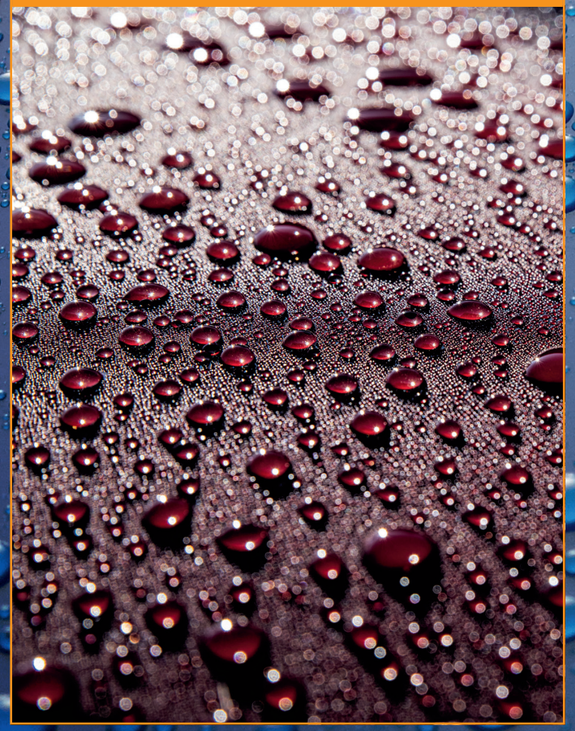
On the surface

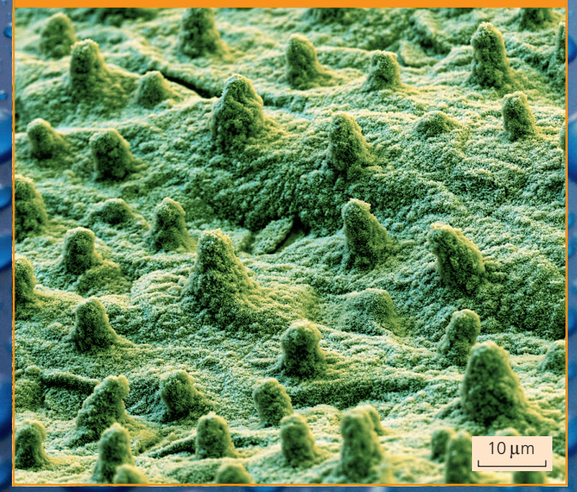
Natural materials can provide inspiration for materials scientists. An example of such *biomimicry* is hydrophobic (water-repellent) paint (1) developed by studying and replicating natural objects, such as lotus leaves (2). A lotus leaf's waxy coating and surface microstructures (3) make it nature's best water repellant, keeping the leaf clean and free from fungi and other organisms.

1 A surface coated in hydrophobic paint



2 Water on a lotus leaf gathers into droplets rather than wetting the surface

3 Scanning electron micrograph of a lotus leaf



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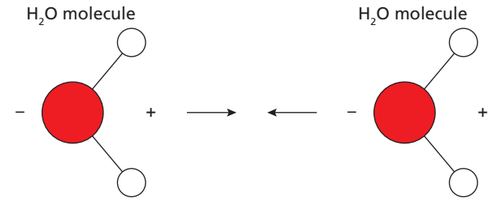
4 Forces between molecules

Weak, short-range forces result from the attraction between oppositely charged regions of neighbouring molecules. These intermolecular forces determine many properties of liquids and solids.

Forces between molecules within a substance are called *cohesive* forces, and those between different substances are *adhesive* forces.

When adhesion between a liquid and solid is stronger than cohesion the liquid wets the solid surface. But when cohesion is stronger the liquid forms droplets, which minimise its surface area.



5 Surface tension

A liquid surface acts like a stretched membrane. The energy needed to extend the surface depends on the strength of the cohesive forces.

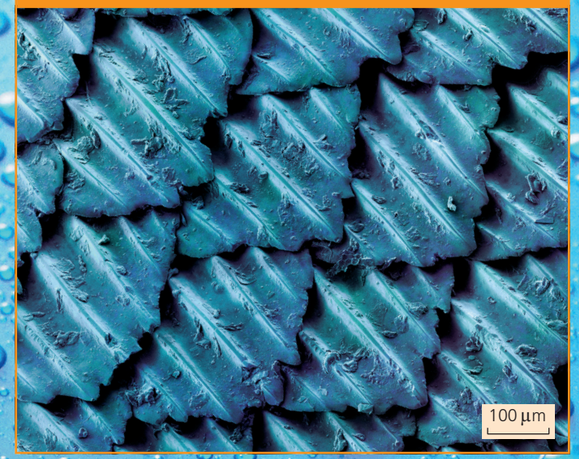
A liquid's *surface tension*, γ, is the cohesive force acting at right angles to a line of 1 m measured along the surface. It is equivalent to the *surface energy* needed to increase the liquid's surface area by 1 m^2.

Water has a higher surface tension than many other liquids:

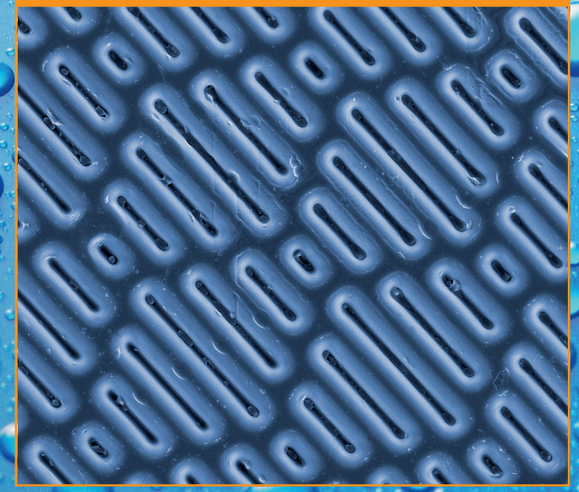
$\gamma = 0.07\,N\,m^{-1} = 0.07\,J\,m^{-2}$

6 A liquid surface can 'stretch' to support small objects, such as pond skaters, without wetting them

7 Scanning electron micrograph (SEM) of shark skin



8 Sharklet antibacterial film



The actions of intermolecular forces (4, 5, 6) help explain why water on a hydrophobic material forms droplets rather than wetting the surface.

A similar principle underlies an antibacterial film modelled on shark skin. Bony, tooth-like, microstructures give shark skin a rough texture (7). These *denticles* deter bacteria and other microorganisms, because the rough surface means they require more energy to grow. Sharklet film (8) can be used on surfaces such as toilet handles and medical devices to help keep them germ free.

For more on Sharklet technology and other examples of biomimicry, go to **https://tinyurl.com/Sharklet-film**.