Wettability

DISCOVER MATERIALS

This pack was brought to you by **Chris Hamlett**,
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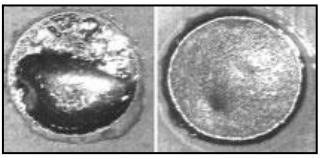
Introduction

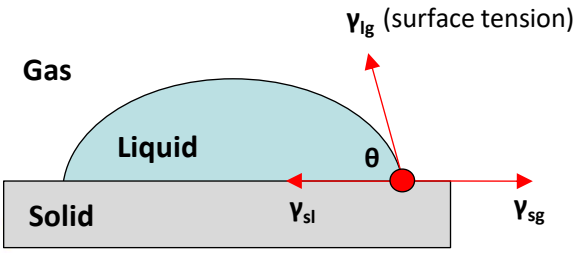
Wettability determines how liquids behave once in contact with a solid surface.

This is important for applications such as cake decoration (how well the icing wets the cakes before solidifying) and ensuring good electrical connections (how well liquid solder wets solid contacts).

Photo from Unsplash by American Heritage Chocolate



From http://www.dataweek.co.za



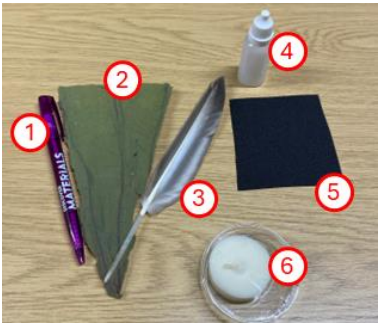
Wettability is defined by the contact angle (θ) and determined by the balance of three interfacial forces:

- Solid – liquid interfacial force (known as 'surface tension')
- Solid – gas interfacial force
- Liquid – gas interfacial force

This pack includes…

An activity which investigates how both the chemistry and texture of a surface affects wettability by studying both manmade and surfaces found in nature.

It will help **if you can get** a holly leaf too.



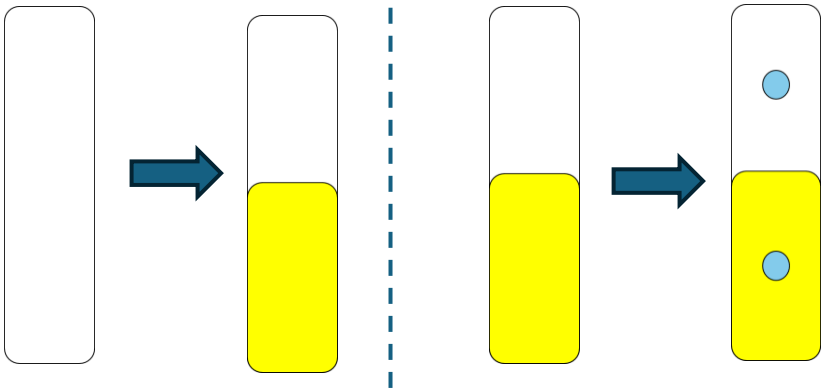
1- Discover Materials Pen
2 - Segment of Lotus leaf
3 - Duck feather
4 - 15ml water dropper bottle
5 - Piece of hydrophobic cloth
6 - Wax candle (in a petri dish)

Activity 1 – effect of surface chemistry

What to do

1) Rub a wax candle over half a glass microscope slide or piece of paper

2) Use the water dropper to put a water droplet on the glass and on the waxy surface



Key: Glass / paper = ☐ Wax: = ■

Q: What do the water droplets look like on the two different surfaces?

What does this mean?

Hydrophilic means 'water loving'
from the Greek: hydro – water and philic – loving

Hydrophobic means 'water hating'
from the Greek: hydro – water and phobic – fearing

From your observations complete the following sentences:

_____ is hydrophilic

_____ is hydrophobic

Activity 2 – effect of surface roughness

A tale of two hydrophobic surfaces - what to do
You need: water dropper, lotus leaf, holly leaf (if available) or the waxy surface from **Activity 1**.

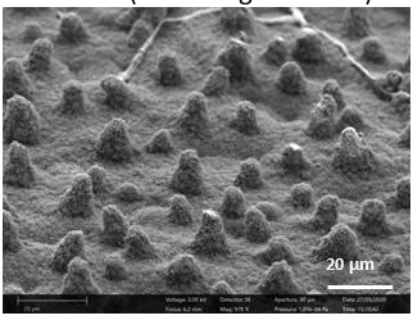
- Put a droplet of water on the darker green side of the lotus leaf and on the other waxy surface (dark green side of a holly leaf or waxy surface)

Q: How does the water droplets behave on two different surfaces?

Images of two waxy leaves

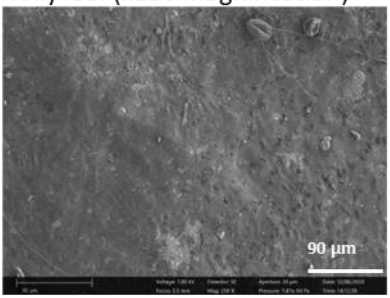
Lotus leaf (photo)

Lotus leaf (x978 magnification)



Holly leaf (photo)

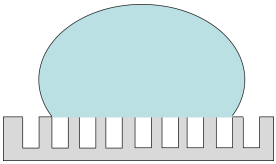
Holly leaf (x250 magnification)



Q: If you have a microscope (or magnifying glass) have a look at the two surfaces. If you have neither look at the photos (and microscope images) of the two waxy leaves – why do you think the water behaves differently on the two surfaces?

What does this mean?

You (hopefully) observed that the water droplet skated off the lotus leaf but didn't move as freely on the other waxy surface.



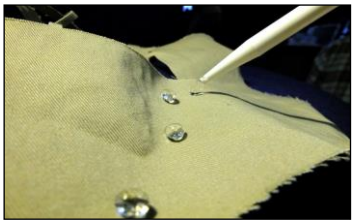
This is because the surface tension of the water droplet allows it to sit on top of the roughness of the surface and make very little contact (and so hardly any friction to stop it moving) – this is a **superhydrophobic**, or water repellent, surface.

What other surfaces are superhydrophobic?

There are lots of examples of superhydrophobic surface in Nature.

Duck feathers which has a rough texture (see the webpage below) and the oily surface is maintained by the duck spreading an oily substance on its feathers.

Water repellent cloth has been developed where the roughness, from the weave of the thread, amplifies the hydrophobicity of either the coating or the yarn itself.



Think about:

- What could other animals and plants use superhydrophobic surfaces for?
- What would you use superhydrophobic surface for?

Learn more

- Natures Raincoats: www.naturesraincoats.com
  A website exploring research into hydrophobic surfaces in Nature
- Natures Surfaces: https://youtu.be/Dy2kFuDABjk
  A video looking at some awesome surfaces found in nature
- Introduction to Materials Science: https://youtu.be/9BDS6X_DeNI
  An introduction to Materials Science and Engineering by Dr Eleonora D'Elia
- Additional information (such as images) and **shopping list** of where we got the items for the activity: https://discovermaterials.co.uk/resource/activity-wettability/

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Check out the Discover Materials website and social media channels on our Linktree Page: