DIY Air Force Activities:

Contact Angle Curve

Materials:

- cup of water
- dropper or straw
- multiple surfaces to test, the surfaces must be flat and level
- a towel in case of spills!

Have you ever noticed how water beads on some surfaces and sticks to others? This can easily be observed in nature after a rainstorm. Look at the leaves and flowers of plants, as well as the sidewalk, driveway, and any wood or glass around your house. Does the surface get wet or repel the water? Wettability describes the ability of a liquid, in this case water, to maintain contact with a solid surface. This is the result of the balance between intermolecular (between molecules) interactions. Adhesive interactions are those between the water molecule and the surface; it's how sticky the surface is. Cohesive interactions are those between the water molecules themselves. The balance between these properties defines the degree of wettability. Depending on the situation, wettability can be good or bad. Scientists developing new materials and coatings (like the wax for your car) use contact angle tests to assess the degree of wettability. A simple form of this test can be done by placing a drop of liquid on the surface and looking at the angle between the surface and the edge of the drop (see the back of this page). For water, hydrophilic, or water loving surfaces yield an angle of less than 90°, this is a good degree of wettability. An angle of 90° is neutral, while an angle greater than 90° but less than 150° describes poor wettability, or a hydrophobic surface. An angle greater than 150° is a superhydrophobic surface. If the water spreads and there is no beading or angle present, then the surface is superhydrophilic.

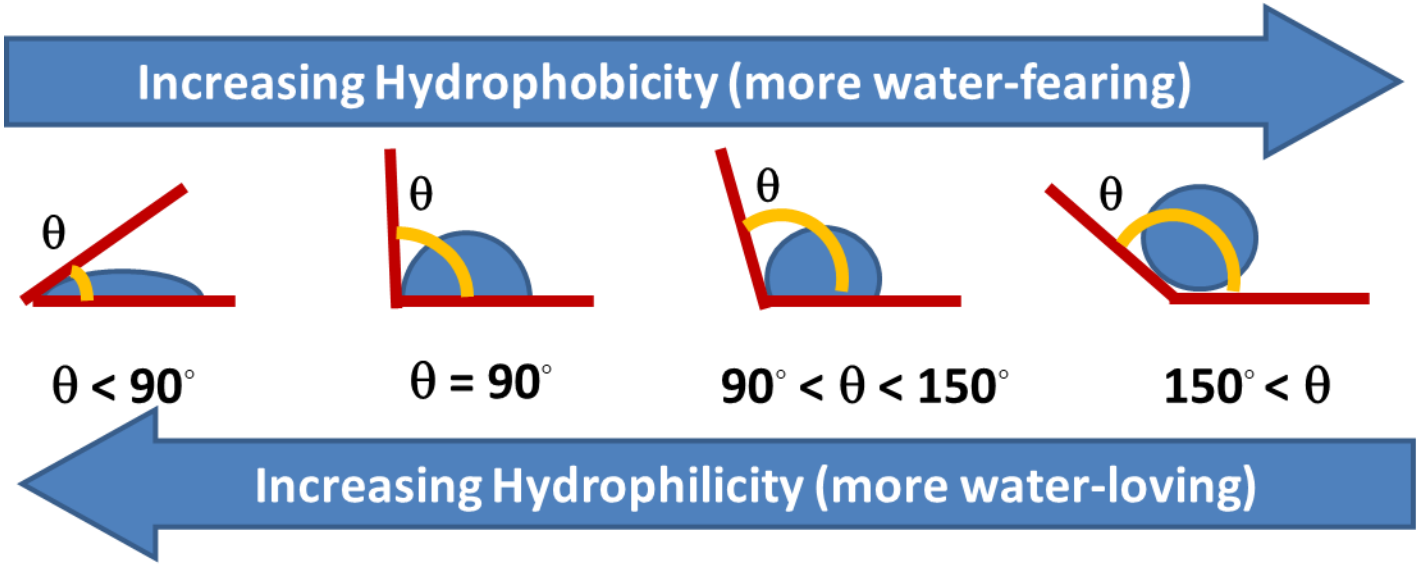
Directions:

1. Select some surfaces to test. Wax paper, aluminum foil, glass plates, tupperware, Mason jar lids, plastic wrap, your deck, the sidewalk, and even the countertop are all great ideas! Just be sure to check with an adult before testing a surface.
2. Use a dropper to let one drop of water fall onto the surface you are curious about. If you don't have a dropper you can use a straw by placing it in the cup of water and capping the other end with your thumb (see the back of this page for an example).
3. Get down to eye level and estimate the contact angle. Is the surface you tested wettable??

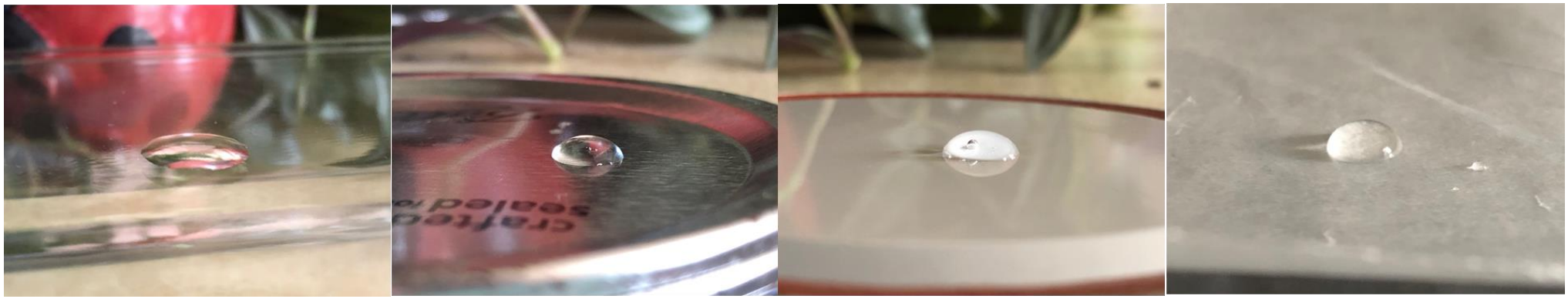
Air Force Associations:

Researchers at the Air Force Research Labs at Wright Patterson Air Force Base in Dayton, Ohio use contact angle measurements when developing new materials and coatings. The liquids they work with are not always water! They are creating superoleophobic (oil repelling) surfaces as well.

If you don't have a dropper you can use a straw! Just put the straw in water and cap the end with your thumb!



The contact angle (θ) between the surface and the edge gives you information on the wettability of the surface. If the liquid is water, it tells you how water-loving (hydrophilic) or water-fearing (hydrophobic) it is. If the angle is less than 90°, the surface is favorable, equal to 150° is neutral, between 90° and 150° the surface is unfavorable, and greater than 150° is highly unfavorable. Below 10° is highly favorable. Remember! The liquid does not have to be water! How do your results change if you test drops of oil? What other liquids could you test?



The molecules that the objects you are testing are made of either attract or repel the water molecules. Glass is polar, and attracts the water, thus the low contact angle. The wax paper repels the water, and the result is a high contact angle. For more on polar and non-polar molecules check out the Marble Print DIY.

https://www.biolinscientific.com/blog/what-is-wettability