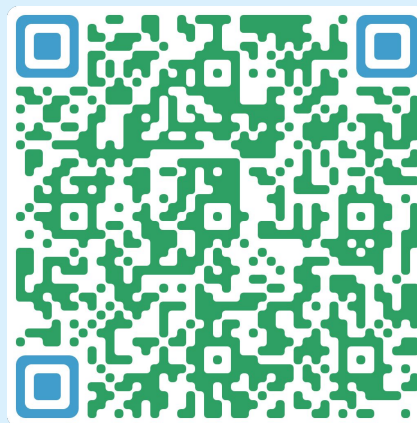


Hydrophobic Marvels

Using Water Models to Unravel the Self-Cleaning Secrets of Lotus Leaves



Andrew Taylor



NABT Baltimore 2023

Andrew Taylor

MS Bio, BS Bio

Olathe Northwest High School
Olathe, KS (near Kansas City)

3DMD Model Teacher
NABT Region IV Coordinator
Current President of KABT

Email: and.taylor07@gmail.com



Workshop Goals

Use water models to explain phenomena.

Make predictions about new scenarios using water models as evidence.



Lotus Leaf Tests

Add a single drop of water to the lotus leaf. Write down qualitative observations of how the drop of water appears and behaves on the lotus leaf.

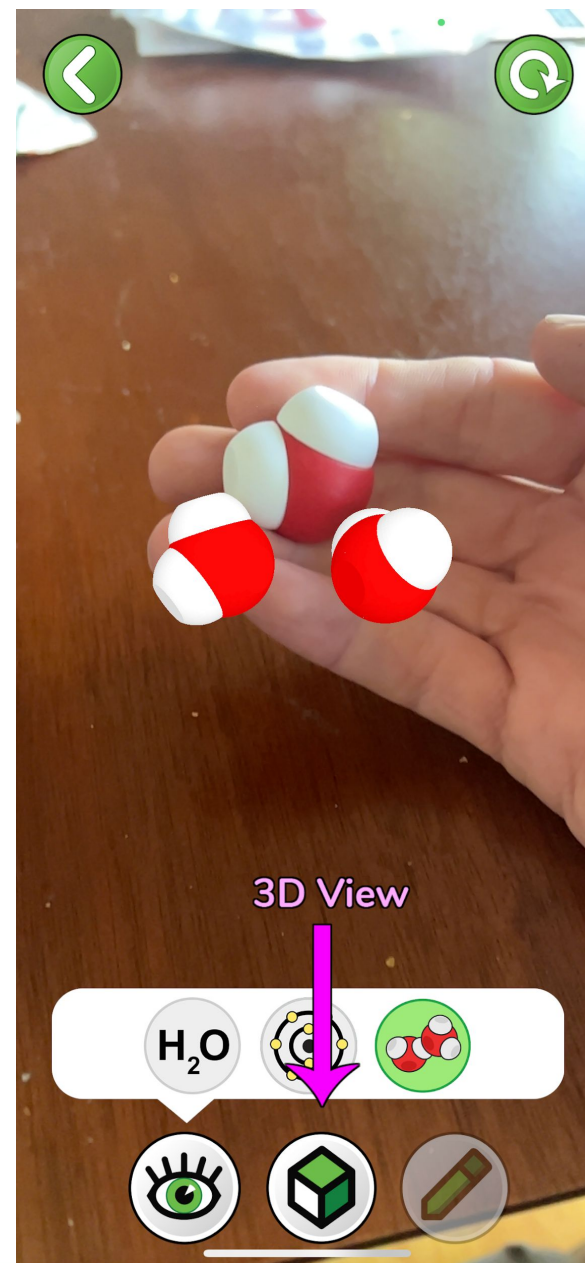
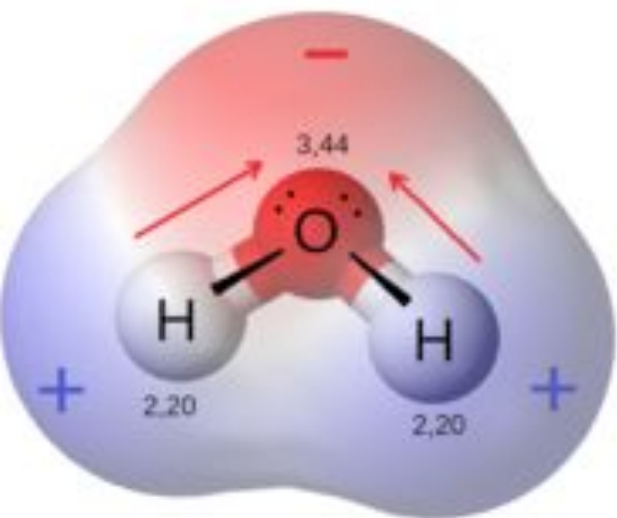
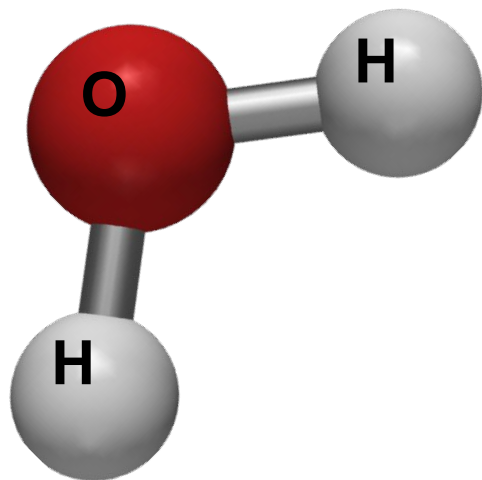


Models!

Ensure each person has just one water molecule from the kit.

What do you notice and wonder? How do the individual water molecules interact with each other?





Models!

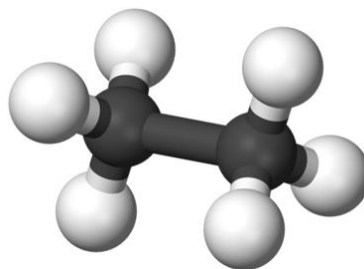
Use a full set (12 water molecules) at your table to try and recreate the phenomena of the water droplet on the lotus leaf.



Models!

Take out the ethane molecule and play with it. See how it interacts with the water molecules.

What do you notice? What do you wonder?



Models!

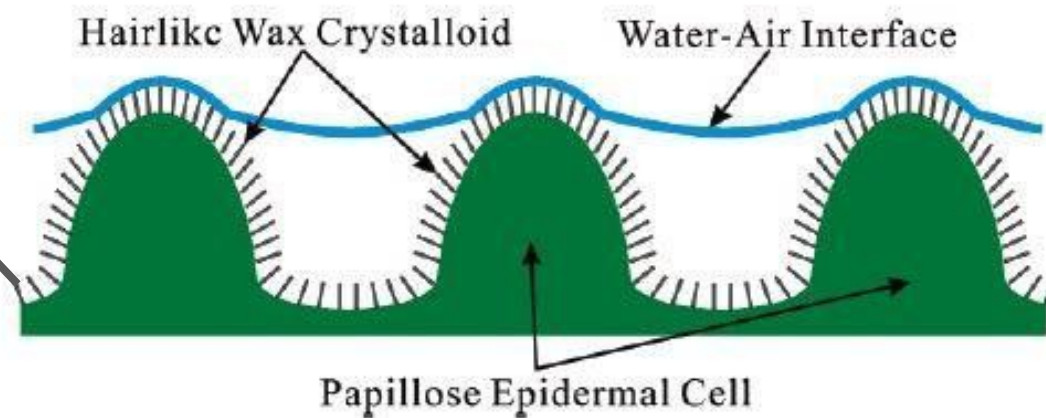
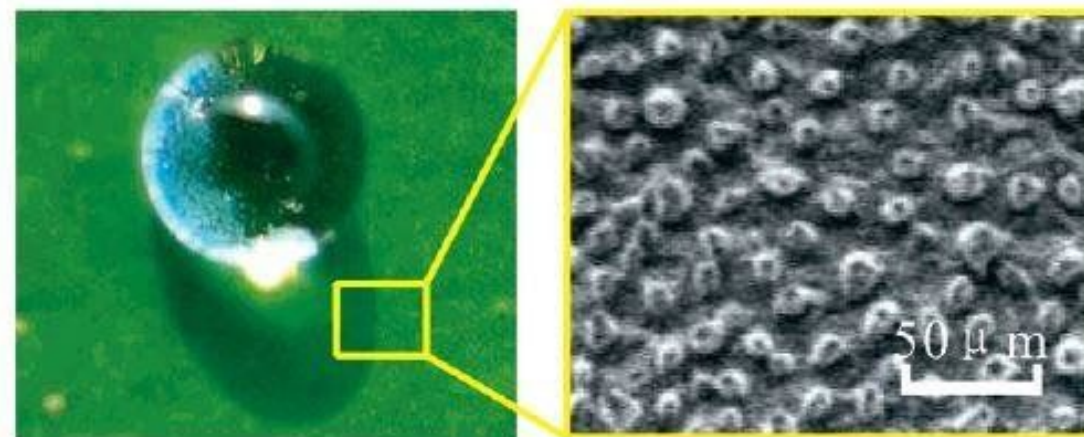
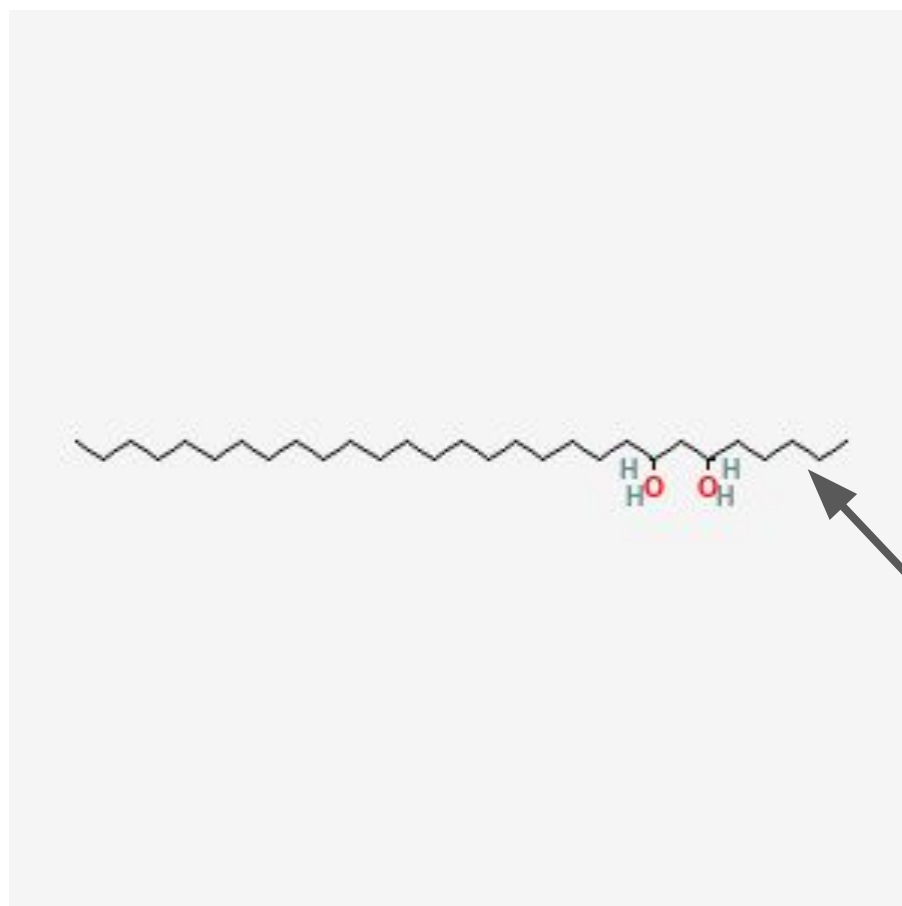
Reflect on the models to create a sketch of how the interactions between the water molecules allow the water to form a rounded ball on the leaf.



Turn and Talk

What would we expect to observe if the leaf surface were charged (polar)?

What would we expect to observe if the leaf surface were neutrally charged (non-polar)?





Self-Cleaning?

Add a sprinkle of glitter to the lotus leaf.

Add a drop of water to the area of the lotus leaf with the glitter.

What do you notice? What do you wonder?

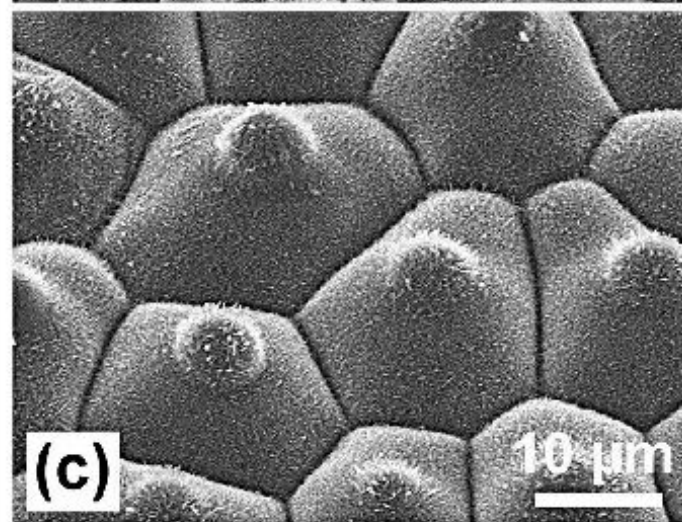
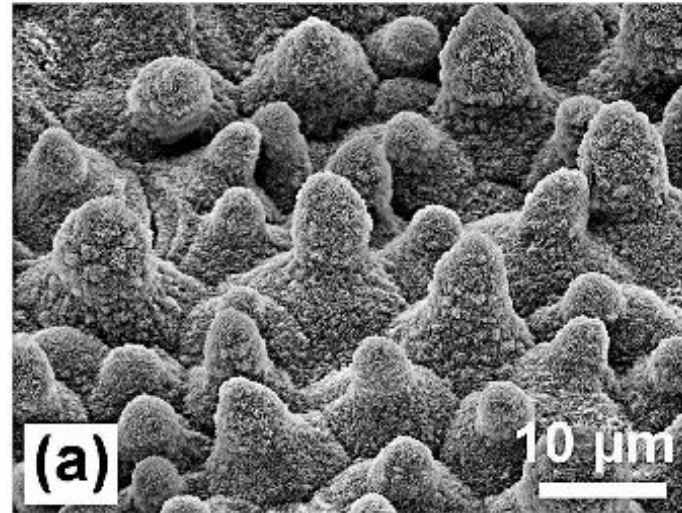


Scanning Electron Microscope Images of Various Plant Leaves

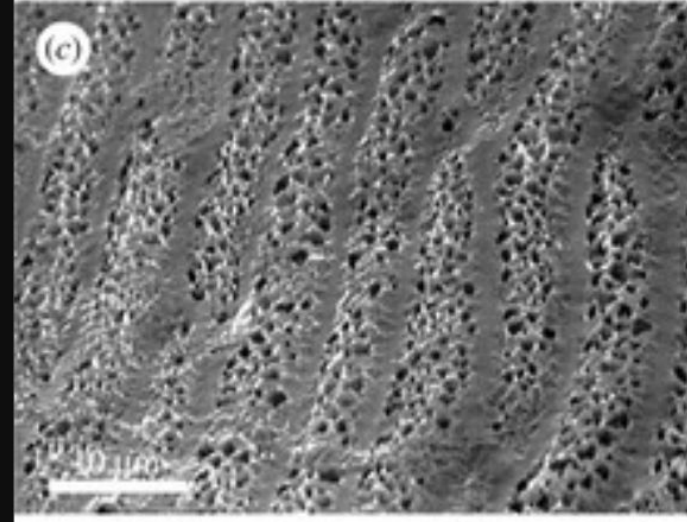
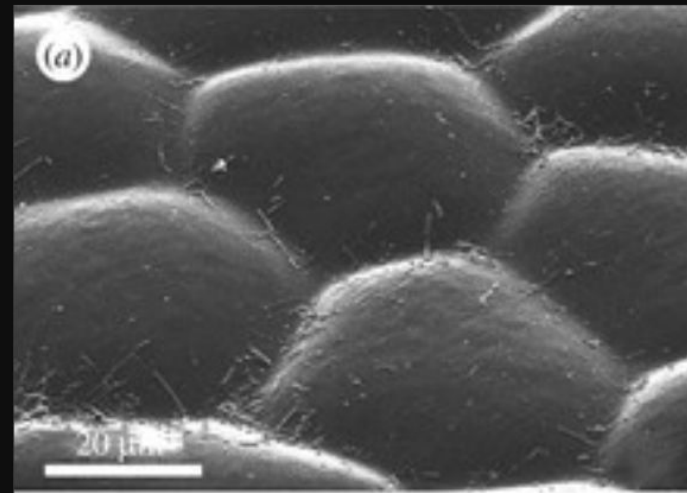
What do you notice? What do you wonder?



Lotus

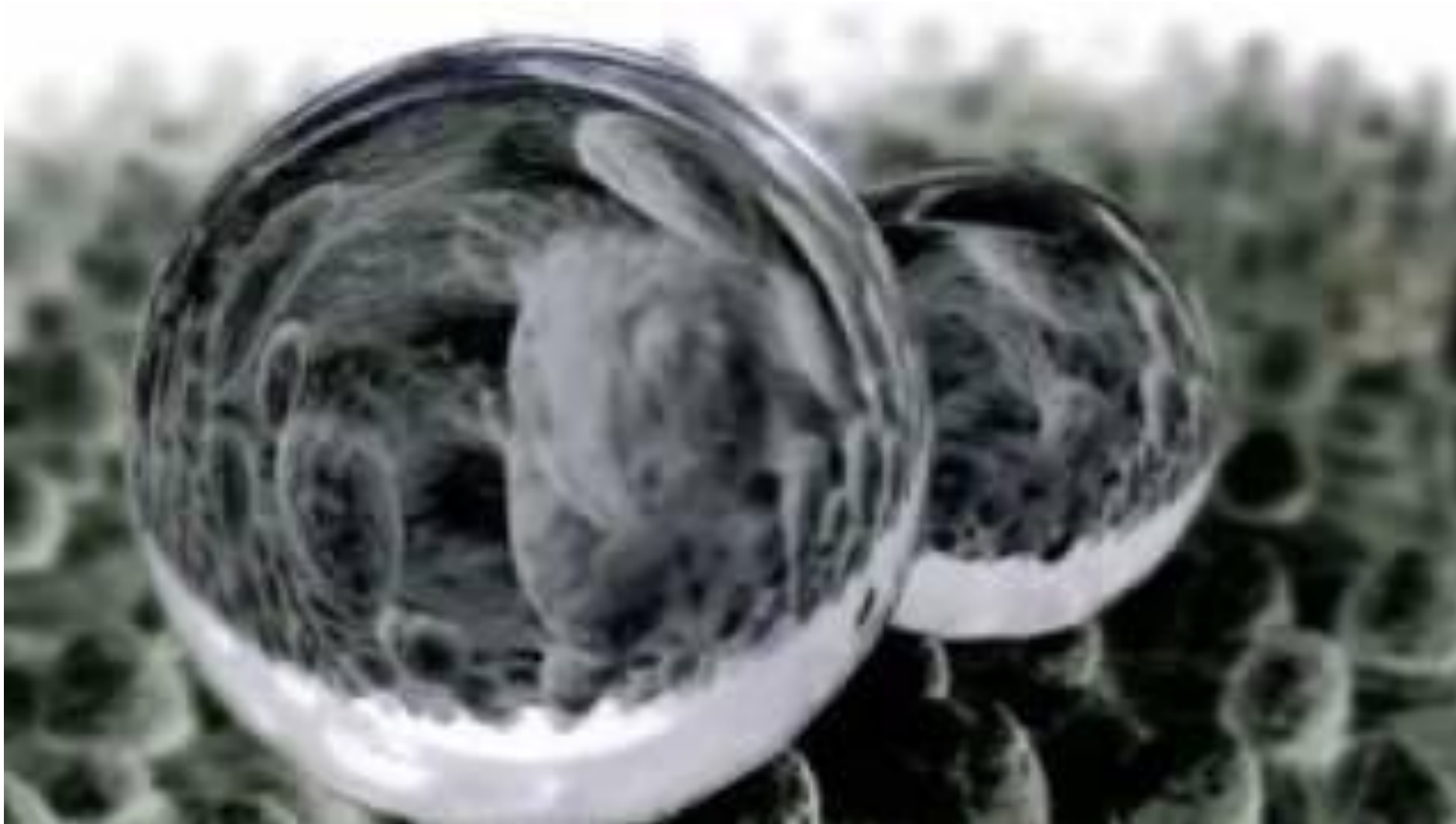


Taro



Hydrophilic Plant
Leaves

The Lotus Effect

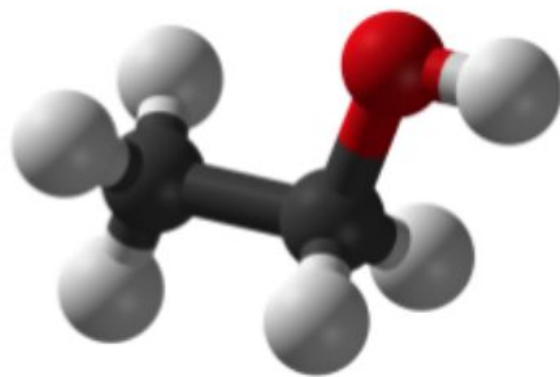


More Models!

Remove a hydrogen from the ethane model. Remove a hydrogen from a water molecule. Place the remaining OH group onto the ethane as seen in the images below.

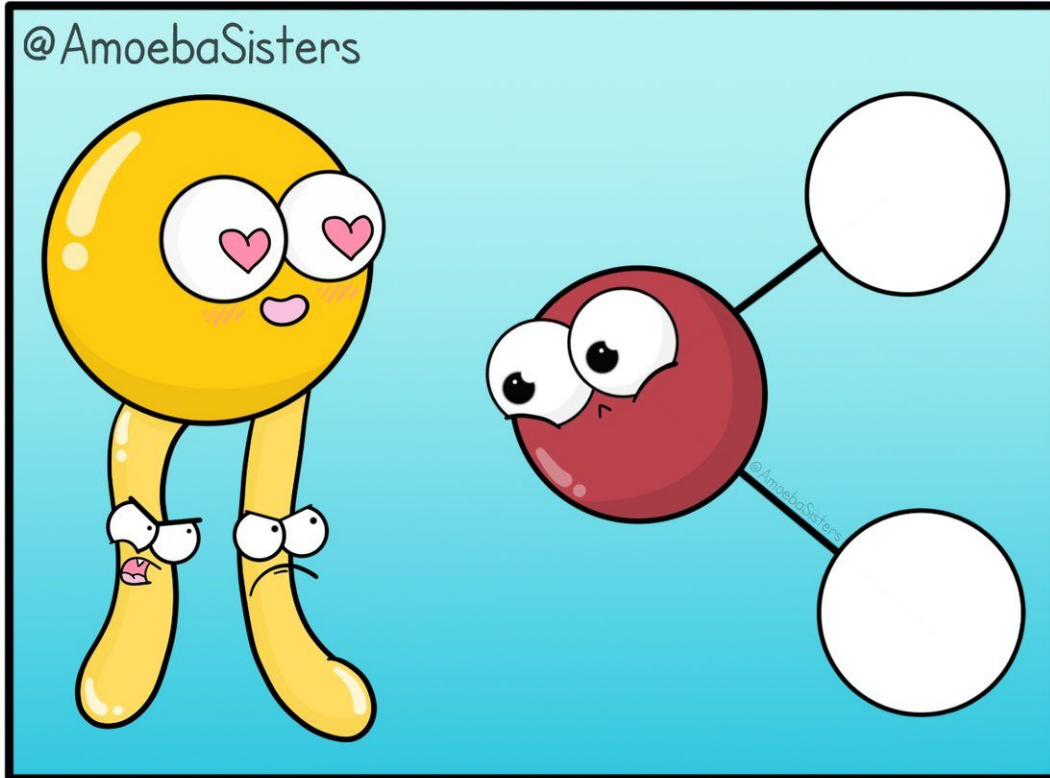
Play with the ethanol molecule, and see how it interacts with the other modeling molecules.

What do you notice? What do you wonder?

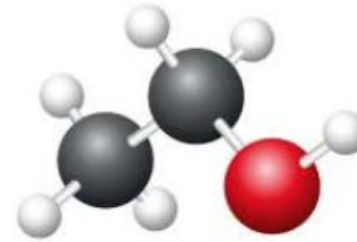


The Ultimate Love/Hate Relationship

@AmoebaSisters

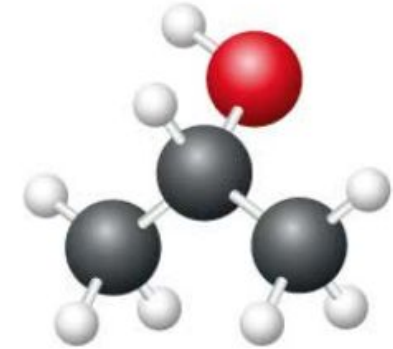
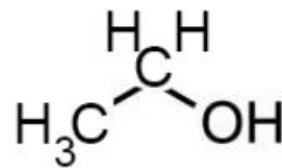


Phospholipids are **amphiphilic** - they have polar heads and nonpolar tails.



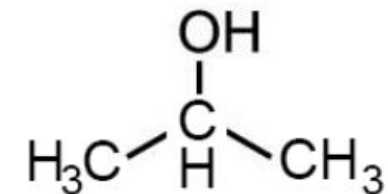
Ethanol

Ethyl alcohol
 $\text{CH}_3\text{CH}_2\text{OH}$
 $\text{C}_2\text{H}_6\text{O}$



Isopropanol

Isopropyl alcohol
 $\text{CH}_3\text{CHOHCH}_3$
 $\text{C}_3\text{H}_8\text{O}$



Predict!

What will happen to isopropyl alcohol when added to the lotus leaf? How will it compare to the water droplet?

The image shows a spiral-bound notebook page. At the top, there is a calendar header with icons for weather (sun, cloud, rain, snow) and a table for the days of the week (Mo, Tu, We, Th, Fr, Sa, Su). To the right of the calendar, there are fields for 'Memo No.' and 'Date'. The page is lined, and the following text is handwritten in blue ink:

I predict that ...

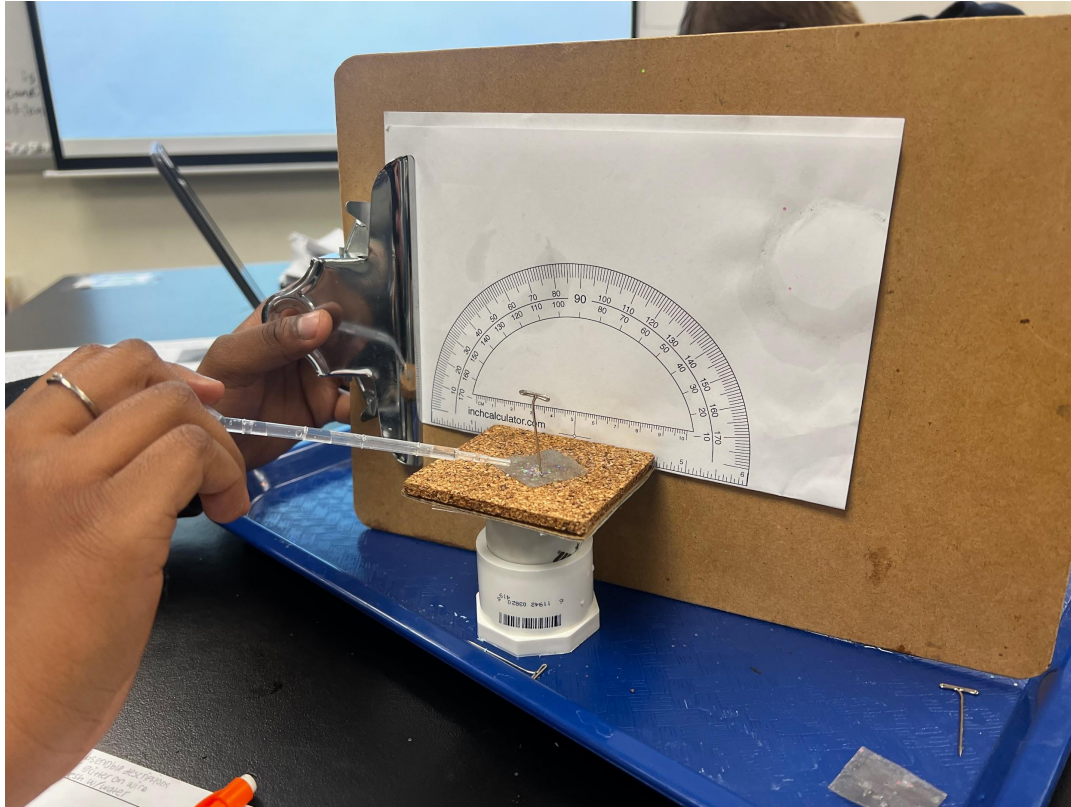
My reasoning for this prediction is...

Test!

Add a drop of isopropyl alcohol to the lotus leaf.

Did your data match up with your prediction?

Biomimicry Engineering Extensions



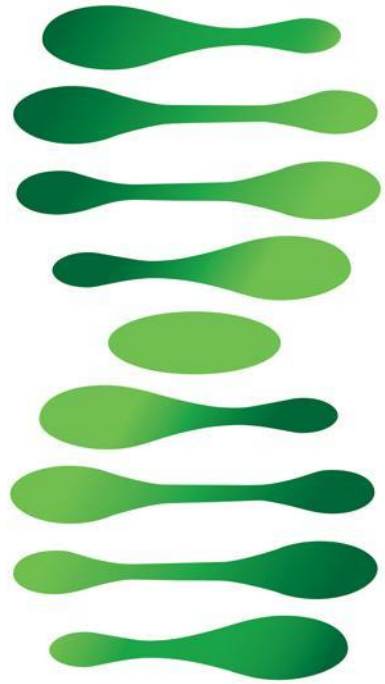


Scan this QR code to fill out a survey for a 20% coupon code off most kits and a chance to win a \$50 gift card!

Kits and models used in this session: Water Kit



Purchase and Borrow Kits from
3DMolecularDesigns.com



Transforming Science Learning

