Forces at the Nanoscale: Activity 2

Nasturtium Leaves

Be-leaf It or Not!

I'm Jasmine. As a volunteer at the San Francisco Botanical Gardens, I water plants with the help of my friend Melinda.

Our question:

Why does water bead up on some leaves and not others?

We headed to San Francisco's **Exploratorium**, where an exhibit on nasturtium leaves explained that these leaves have waxy nanohairs that make them water-repellent. We also learned that surface tension is the force holding the water into tight droplets. The museum staff even gave us a sample of nanopants fabric, a material that mimics the leaves. We collected other plants with hairy leaves to test their ability to repel water. Then, we took our nasturtium leaf and nanopants samples to **Stanford University** for an up-close look to compare their structures.

Nano Matters

Water molecules on the surface are attracted to one another and want to stick together. Although the force holding each individual molecule to one another is weak, there is power in numbers. The "skin" of water is quite strong (a force called surface tension) and can be observed at the macroscale. When water hits another surface, the water molecules can stick to one another OR to the molecules of the surface they are sitting on. The result of this competition leads to water beading up on some surfaces and spreading out on others. In the case of the nasturtium leaf, surface tension dominates and the water stays in a tight sphere.

Icebreaker

Explore surface tension with this simple activity.

15 minutes

DragonflyTV Skill: Predicting

Guide your kids as they

1) Predict how many pennies can be placed in a full glass of water before it overflows.
2) Fill a glass to the rim with water.
3) Carefully add pennies one by one to the glass. Notice how the water curves in a mound above the rim.
4) Try this activity with quarters or even half dollars!

You'll need:

- glass
- water
- pennies
- other coins

Are you a nano-bit curious?

Water has a large amount of surface tension, which means that water molecules like to stick to each other and form a strong "skin." This is the reason water striders and other water insects can walk so easily across a pond. To see this "skin" in action another way, try floating pennies, paper clips, and even quarters on top of pan of water like Jasmine and Melinda did at the Exploratorium!

Investigation
Check out the properties of everyday plants.

1 hour or more depending on the number of leaves and tests

Guide your kids as they

1) Break into groups. Collect several types of "hairy" leaves. (some suggestions are given on the right.)
2) Make a table of the properties your group wants to observe. Some examples include: the size and spacing of hairs and the texture of the leaves.
3) Place individual drops of water on the leaves. Record your observations.
4) Submerge the leaves in water. Record your observations.
5) Encourage students to make drawings of their observations in the table. Draw the leaf or do a leaf rubbing. Draw the hairs as they appear under a magnifying glass or the shape of the water droplet (whether it beads up or flattens out).

You'll need:

- leaves from various plants (geranium, nasturtium, lamb's ear, begonia)
- water
- eye dropper
- magnifying glass
- notebook and pencil

DFTV Science Helper

Other leaves that behave in a similar fashion to the nasturtium are lotus, kale and cabbage.

Are you a nano-bit curious?

The nasturtium leaf is superior at shedding water, even after being submerged. That's because the hairs on the nasturtium leaf are nanosized and waxy. The hairs are too small to see with your eye or even a magnifying glass. A special microscope, such as a scanning electron microscope (SEM), is needed. As the hairs on the other leaves you tested get smaller and closer together, the leaves behave more like the nasturtium leaf, but none quite compare. See the **Image Gallery** on page 67 for SEM images of a nasturtium leaf.

nano

Watch the "Zoom Cab" feature in show 704: Forces at the Nanoscale for an up-close view of a mint leaf.

DFTV Kids Synthesize
Data and Analysis

Organize your data as you compare leaves. You might want to make a table that looks like this one. You can attach the leaves themselves, and leaf drawings or leaf rubbings to the table.

	Hairs	Texture	Drop water on it	Dunk in water
Nasturtium	No visible hairs even with magnifying glass	Soft, smooth	Beads up, round balls, "jumps" off the leaf 	The same!!
Geranium	Peach fuzz-like hair seen with magnifying glass	Feels like fine grain sandpaper	Beads up a bit... more oval shaped than round 	Gets patches of wetness
Begonia	Can visibly see large hairs (looks like beard stubble)	Rough	Water flattens 	Gets wet and sinks
Lamb's ear	Lots of intertwined hairs in multiple layers	Velvety soft	Beads up, round balls 	Gets soaked like a sponge! Water doesn't bead up anymore

Keep Exploring!

Try dropping honey or syrup on the nasturtium leaf. Does it stick?

Look around at the trees in your neighborhood. How do they behave after a rain storm? Why might some leaves shed water and others absorb it? How does this behavior serve the plant? Do the plants get water from the leaves or the roots? Does it depend on the climate the plant lives in?