



stain resistant fabric

GOAL:

Visitors will understand how the nano-scale construction of Nano-Tex® fabric results in its stain-resistant properties.

MATERIALS:

Real Product

- Swatches of regular fabric
- Swatches of Nano-tex® fabric
- 16 oz. squirt bottle of water
- Waste bucket
- Paper towels
- 2 4 oz. squirt bottles for additional stains (optional)
- Additional stains (optional)
- Laundry bucket (optional)
- Laundry detergent (optional)

Macro-scale

- Fabric model
- Fuzzy die “stain droplet” with Velcro dots

PROCEDURE:

Set-up:

1. Lay out all supplies. You may want to protect the workspace with newspaper or a towel.
2. (Optional) If you are using additional stains, transfer samples of the stain materials to small squirt bottles. Prepare a laundry bucket by adding some laundry detergent to a small container of water.

Doing the demonstration:

1. Show visitors a swatch of Nano-tex® fabric and a swatch of regular fabric. Allow them to feel both swatches. Ask them to guess which swatch is Nano-tex® fabric.



2. Have a visitor squirt some water on each swatch and watch what happens. The liquid will soak into the regular fabric, but will bead up and roll off of the Nano-tex[®]. Explain that the Nano-tex[®] fabric has a coat of carbon “nano-whiskers” permanently bonded to the surface of the fabric. These nano-whiskers form a protective layer that makes watery and oily stains bead up and roll off the fabric.
3. (Optional) Repeat step 2 with additional stains, if using. Instruct visitors to apply a “dime-sized” squirt of each stain on the fabrics. Use the squirt bottle of water to rinse the stain off the Nano-tex[®] fabric and soak the regular fabric in the laundry bucket.
4. Use the macro-scale fabric model to illustrate the principle. The fuzzy die with Velcro hook dots represents a stain droplet. First have the visitor throw the “stain” on side with the plain Velcro loop surface (representing regular fabric). Turn the model upside down. The “stain” will stick, just as a stain soaks into regular fabric.
5. Next, have the visitor throw the “stain” on the spiky surface (representing the nano-whiskers on stain-resistant fabric). Turn the demo upside down. The beanbag will fall off, just as a stain beads up and rolls off Nano-tex[®] fabric.

Clean-up:

1. Allow used Nano-tex[®] swatches to dry. They can be reused quickly, even if used with additional stains; rotating three swatches is usually sufficient.
2. Place used regular fabric swatches aside to dry overnight. If using water only, they can be reused without laundering. (Optional) If using additional stains, immediately soak used swatches of regular fabric in soapy water to help get stains out. Launder regular fabric swatches as soon as possible after being stained to maximize reuse.
3. Wipe up work surface and throw away any wet newspaper/paper towels. Gather all materials and return to storage.

EXPLANATION:

The invention of Nano-tex[®] fabric was inspired by the observation of the water-repellant and self-cleaning properties of the leaves of the lotus plant. Two factors are central to this natural phenomenon: physical structure and chemistry. First, the surface cells form dense microstructures that look like round spikes. These tiny structures decrease the contact area between the leaf and a water droplet and create a cushion of air that minimizes absorption. Second, the lotus leaf microstructures are covered in nano-scale wax crystals, which are hydrophobic and therefore repel water.

Similarly, Nano-tex[®] fabric is made of 100% cotton fibers coated with rough, hydrophobic molecules commonly called “nano-whiskers”. These tiny fibers (10-100 nm) are 1/1000th of the size of a normal cotton fiber and are permanently bonded to the surface of the fabric, mimicking the surface structure of a lotus leaf or peach fuzz.



The nano-whiskers are made of carbon-based hydrophobic polymers called *perfluoroalkanes*. These polymers contain fluorine and are similar to the molecules found in Teflon®. Although industrial fluorochemistry has been associated with non-favorable environmental and health effects, scientists have thus far been unable to produce the same level of repellence with less hydrophobic nano-fibers alone.

Nano-tex® fabric is produced by immersing cotton in a water-based suspension of nano-whiskers. The soaked fabric is then heated so the water evaporates, leaving the nano-whiskers to form a chemical bond with the cotton fibers. As a result, this treatment is much longer lasting than other stain-proofing treatments that merely coat the surface of the fabric without bonding.

Nano-tex® fabric is currently being used in apparel, home textiles, and commercial fabrics. Clothes made from Nano-tex® fabric are available from Old Navy, Eddie Bauer, and L.L. Bean, among other retailers.

WHAT COULD GO WRONG?

This activity can get messy, depending on the enthusiasm of your visitors. Do not do this demonstration with others that require electrical devices. If you use stains other than water, see the General Maintenance section for advice on which stains to choose. Use the small squirt bottles for stains to encourage visitors to apply only small amounts.

GENERAL MAINTENANCE:

Maintenance is simple if you are only using water, since the fabric swatches can be laid out to dry with no laundering necessary.

If you use additional stains, product literature from Nano-tex® claims that the fabric is resistant to:

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| Coco-Cola™ | Champagne | Grape juice | Tomato juice |
| Generic cola | Half & half | Chocolate syrup | Soybean oil |
| Whole milk | Ginger ale | Beet juice | Peanut oil |
| Orange juice | Coffee | Red wine | Hot sauce |
| Cranberry juice | Sunflower oil | Soy sauce | Corn oil |
| Apple juice | Coffee with milk | Soy milk | Salad dressing |
| | Kool-aid™ | Chocolate milk | Olive oil |

In in-house testing of ketchup, mustard, mayonnaise, ranch dressing, barbecue sauce, and chocolate sauce, all washed off after a two-minute surface application, but only ketchup, chocolate sauce, and barbecue sauce washed out when rubbed in and/or allowed to sit for two days. **We recommend that you do not rub in stains or use mustard, mayonnaise, or ranch dressing. Rinse stains off of Nano-tex® swatches immediately; soak and launder regular swatches as soon as possible. If Nano-tex® swatches get completely soaked or machine laundered, they must be dried with heat to restore stain repellence.** Also note that regular fabric will wrinkle in the dryer but Nano-tex® will not, resulting in a visible difference between the swatches.