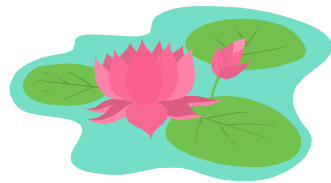


# The Lotus Effect Worksheet



## Introduction

In many Asian cultures, the lotus plant is a symbol of purity. It rises from the muddy bottom of ponds and lakes to emerge pristine on the surface of the water. In this lab, you will study the properties of the lotus plant that allow it to remain clean despite the elements, as well as cloth treated with a synthetic lotus-like coating.

## Equipment

- 2 lotus leaf pieces
- Nano-Text™ cloth
- cup of water
- pipette
- dirt
- lab gloves
- tweezers
- ice cube
- Petri dish

## Procedure

### A. Pre-Lab

1. **Place** an ice cube in the Petri dish.
2. **Holding** one lotus leaf piece with the tweezers, **lay** the leaf on the ice cube.
3. **Set** the ice cube and lotus leaf aside for Part C: *Motion and the Lotus Effect*.

### B. Water and the Lotus Effect

1. **Pick up** the second lotus leaf piece with the tweezers and **place** a few drops of water onto the leaf. **Record** your observations in the table, below.
2. **Submerge** the lotus leaf into the cup of water. **Record** your observations.
3. **Lift** the lotus leaf out of the water. Is the leaf wet? **Record** your observations.
4. **Sprinkle** dirt onto the lotus leaf. **Place** a few drops of water onto the leaf and tilt it so the water runs through the dirt. Record your observations.
5. **Repeat** steps 1-4 using the Nano-Text™ cloth instead of the leaf.

	Lotus Leaf	Nano-Text™ Cloth
Water drops on surface		
Submerged in water		
Lifted out of water		
Dirt and water on surface		

### C. Motion and the Lotus Effect

1. **Retrieve** the lotus leaf on ice from Part A.
2. **Observe** water vapor that has condensed on the leaf surface. If you see no droplets 1 mm or larger, **breathe** gently on the leaf, as if you were fogging up a window.  
The droplets will grow larger.
3. *Very gently and slowly*, use the tweezers to **lift** the leaf off of the ice cube.
4. Gently **turn** the leaf on its side. **Describe** the behavior of the water drops. How is this different from the behavior of the water droplets in Part B?
  
5. **Add** mechanical energy to the lotus leaf by **sharply tapping** or **flicking** the tweezers. **Describe** the behavior of the water droplets.

### D. Damage and the Lotus Effect

1. **Study** the three larger pieces of the Nano-Tex™ cloth. What **types** of damage might occur to the cloth during regular wear?
  
2. **Choose** one type of damage you can inflict on the cloth to study *safely* Below, **describe** how you define “slightly damaged,” “moderately damaged,” and “highly damaged.”
  
3. **Label** each piece of cloth “slightly-,” “moderately-” or “highly”-damaged and proceed to **damage** the three pieces accordingly.
  
4. Use a pipette to **drop** water on each damaged cloth. Below, **describe** how the damage affected the ability of each cloth to shed water.
  
5. Taking into account your results above, what are some uses for which this cloth may be too fragile? Why?

### Conclusion

1. The Nano-Tex™ cloth is an example of biomimicry. The self-cleaning properties of the lotus plant were studied and a synthetic version of its surface was developed. When this treatment is added to fabric, the garments repel dirt and stains just like the lotus plant. What other products could benefit from a self-cleaning surface? Include at least three examples and explain how the self-cleaning ability would be especially useful for each application.
  
2. Water droplets formed from dew or other condensation may act differently on superhydrophobic surfaces than water poured or dropped on these surfaces. Does this limit the applications for self-cleaning surfaces? How could some products be modified to help self-cleaning products work even for water condensation? Write at least one paragraph to answer each question.