

# 生物策略表

HWC, 2022/4/10

類別	生物策略 (Strategy)
生物策略 STRATEGY	表面可以自我清潔(Surface Allows Self-Cleaning)
生物系統 LIVING SYSTEM	聖蓮花(Sacred lotus)
功能類別 FUNCTIONS	#防止過量液體 #防止污垢/固體 #Protect From Excess Liquids #Protect From Dirt/solids
作用機制標題	由於疏水性微尺度凸起，神聖蓮花的葉子可以自我清潔 (Leaves of the sacred lotus are self-cleaning thanks to hydrophobic microscale bumps)
生物系統/作用機制 示意圖 (確認版權、註明出處；畫質)	
作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)	
<p>荷葉表現出廣泛的折疊（即乳突狀表皮細胞 papillose epidermal cell）和從植物表面突出的表皮蠟晶體 (epicuticular wax crystals)，導致微尺度表面粗糙。由於水和空氣的黏附性不如水和固體好，因此粗糙表面往往會降低水滴上的粘附力，因為粗糙表面的間隙空間中截留的空氣會導致液體與固體的接觸面積減少。這使得水的極性分子的自吸引力能夠更充分地表達，使其形成球體。</p> <p>葉子表面的污垢顆粒粘在這些液滴上，這既是由於水和固體之間的自然黏附，也是因為與葉子表面的接觸從葉子的微觀形貌上減少了95%以上。葉片表面的最微小角度（例如，由微風引起）然後導致水球由於重力而滾落，將附著的污垢顆粒帶走並清潔葉片，而無需使用清潔劑或消耗能量。</p> <p>Lotus leaves, for example, exhibit extensive folding (i.e., papillose epidermal cells) and epicuticular wax crystals jutting out from the plant’s surface, resulting in a roughened microscale surface. As water and air adhere less well than water and solids, roughened surfaces tend to reduce adhesive force on water droplets, as trapped air in the interstitial spaces of the roughened surface result in a reduced liquid-to-solid contact area. This allows the self-attraction of the polar molecule of water to express more fully, causing it to form spheres.</p> <p>Dirt particles on the leaf’s surface stick to these droplets, both due to natural adhesion between water and solids and because contact with the leaf surface is reduced by over 95% from the leaf’s micro-topography. The slightest angle in the surface of the leaf (e.g., caused by a passing breeze) then causes the balls of water to roll off due to gravity, taking the attached dirt particles with them and cleaning the leaf without using detergent or expending energy.</p>	

## 文獻引用 (REFERENCES)

“植物表面的微浮雕 (microrelief)，主要由表皮蠟晶體引起，具有不同的用途，通常會產生有效的防水性。此外，減少了污染顆粒的黏附。根據實驗數據……這裏首次表明，表面粗糙度、降低的顆粒黏附性和防水性之間的相互依賴性，是許多生物表面自清潔機制的基石。植物被各種顆粒人工污染，隨後通過灑水器或噴霧器進行人工沖洗。在防水葉子下，顆粒被從表面滾落的水滴完全去除，而與它們的化學性質或大小無關。荷 (*N. nucifera*) 的葉子為這種效應提供了令人印象深刻的演示，因此被稱為“蓮花效應”，並且可能具有重要的生物學和技術重要性。” (Barthlott 和 Neinhuis 1997:1)

“The microrelief of plant surfaces, mainly caused by epicuticular wax crystalloids, serves different purposes and often causes effective water repellency. Furthermore, the adhesion of contaminating particles is reduced. Based on experimental data...it is shown here for the first time that the interdependence between surface roughness, reduced particle adhesion and water repellency is the keystone in the self-cleaning mechanism of many biological surfaces. The plants were artificially contaminated with various particles and subsequently subjected to artificial rinsing by sprinkler or fog generator. In the case of water-repellent leaves, the particles were removed completely by water droplets that rolled off the surfaces independent of their chemical nature or size. The leaves of *N. nucifera* afford an impressive demonstration of this effect, which is, therefore, called the ‘Lotus-Effect’ and which may be of great biological and technological importance.” (Barthlott and Neinhuis 1997:1)

## 參考文獻清單與連結 (REFERENCE LIST) Harvard 或 APA 格式

Purity of the sacred lotus, or escape from contamination in biological surfaces  
Planta | 25/08/2002 | W. Barthlott, C. Neinhuis

Characterization and Distribution of Water-repellent, Self-cleaning Plant Surfaces  
Annals of Botany | 07/10/2002 | C NEINHUIS

Nature's Raincoats (<https://naturesraincoats.com/>)

延伸閱讀: Harvard 或 APA 格式 (取自 AskNature 原文; 若為翻譯者補充, 請註明)

## 生物系統延伸資訊連結 (LEARN MORE ABOUT THE LIVING SYSTEM/S)

### 撰寫/翻譯/編修者與日期

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### AskNature 原文連結

<https://asknature.org/strategy/surface-allows-self-cleaning/>