

生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	離子釋放造成收縮 (Ion release causes contraction)
生物系統 LIVING SYSTEM	溝鐘蟲 <i>Vorticella convallaria</i>
功能類別 FUNCTIONS	#改變大小/形狀/質量/體積 #Modify size/shape/mass/volume
作用機制標題	溝鐘蟲的柄透過釋放鈣離子而收縮 [The stalk (spasmoneme) of the <i>V. convallaria</i> protozoan contracts via release of calcium ions.]
生物系統/作用機制示意圖	 <p>Source: https://upload.wikimedia.org/wikipedia/commons/f/f9/Vorticella_convallaria.jpg</p>
作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)	
文獻引用 (REFERENCES)	
<p>「生物工程師希望未來能用於小型裝置之微型彈簧，其靈感是來自一個住在浮渣中的池塘微生物。」</p> <p>「麻省理工學院的 Danielle France 正在研究一種原生生物溝鐘蟲 <i>Vorticella convallaria</i>，它能以柄狀構造 (spasmoneme) 將自己附著在岩石或荷葉，甚至其他浮游生物上。當此生物受到干擾時，柄狀構造會突然收縮，就像拉長的電話線彈回原本一圈一圈的樣子。Danielle France 說：『我們認為它是以儲存能量進行這樣的動作。』... Danielle France 在 2005 年於美國舊金山舉行的美國細胞生物學學會會議上發表了在輪轉式的顯微鏡載物台上旋轉溝鐘蟲的細胞，並將其曝露於 10,000g 加速度下的實驗。即使對抗龐大的合力，細胞仍然可以收縮柄狀構造。研究人員計算出收縮柄狀構造會產生至少 300 奈米牛頓的力。這聽起來好像不多，但 Danielle France 表示就其尺寸而言，鐘蟲的柄狀構造比汽車的引擎還要更強大。」</p>	

「這種強大的納米彈簧是由細胞釋放鈣離子所觸發。柄狀結構包含六種來自中心蛋白 (centrin) 家族的蛋白質。藉由使用抗體輪流使每種中心蛋白失去功能，Danielle France 和她的同事們確認了一種叫做中心蛋白 5 的蛋白質，似乎對鈣離子訊號特別敏感。」
(Aldhous 2005: 12)

“A scum-dwelling pond microbe is the inspiration for minute springs that bioengineers hope will operate tomorrow's miniaturised devices.”

“Danielle France at the Massachusetts Institute of Technology is studying a protozoan called *Vorticella convallaria*, which can attach itself to rocks, lily pads and even other creatures in the plankton using a stalk called a spasmoneme. When the protozoan is disturbed, the spasmoneme contracts abruptly, like a stretched telephone lead springing back into a coiled shape. 'We think that it operates on stored energy,' says France...France told the American Society for Cell Biology meeting in San Francisco [in 2005] about experiments in which she spun *Vorticella* cells on a revolving microscope stage, exposing them to accelerations of 10,000g. Even working against the colossal resulting forces the cells could still contract their spasmonemes. The researchers calculate that a contracting spasmoneme exerts a force of at least 300 nanonewtons. That might not sound like much, but France says that, for its size, *Vorticella*'s spasmoneme is more powerful than a car engine.”

“The mighty nanospring is triggered by the release of calcium ions from the cell. The spasmoneme contains six proteins from a family called the centrins. By using antibodies to disable each centrin in turn, France and her colleagues have identified one, called centrin 5, that seems especially responsive to the calcium signal.” (Aldhous 2005: 12)

參考文獻清單與連結 (REFERENCE LIST)

Aldhous, P. (2005). Whiplash spring hurls plankton to engineering fame. *New Scientist* 188: 12.
(<https://web.a.ebscohost.com/ehost/detail/detail?vid=0&sid=d1775976-fc39-4241-909b-2fca7fdb59ac%40sessionmgr4006&bdata=Jmxhbmc9emgtDHcmc2l0ZT1laG9zdC1saXZl>)

延伸閱讀: Harvard 或 APA 格式

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

https://en.wikipedia.org/wiki/Vorticella_convallaria

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AskNature 原文連結

<https://asknature.org/strategy/ion-release-causes-contraction/>