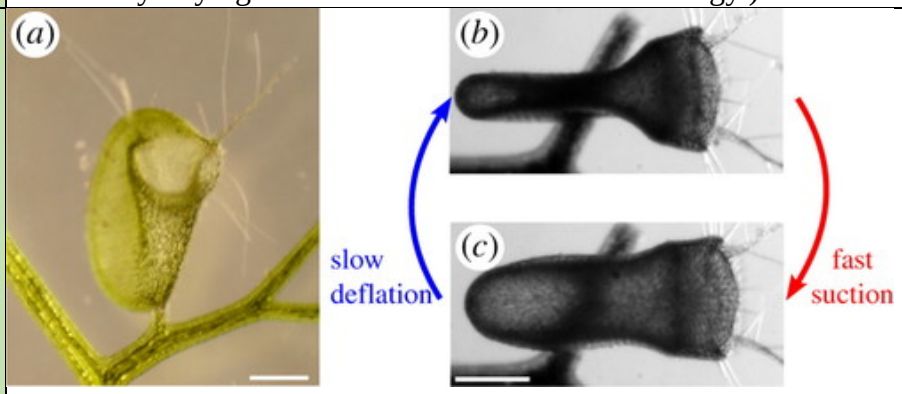
生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	彈性的壁促成極快速的被動性吸入 (Flexible walls allow for ultra-fast passive suction)
生物系統 LIVING SYSTEM	浮囊狸藻 *Utricularia inflata* (Swollen Bladderwort)
功能類別 FUNCTIONS	#獲得、吸收、或過濾液體 #獲得、吸收、或過濾生物 #貯存能量 #Capture, absorb, or filter liquids #Capture, absorb, or filter organisms #Store energy
作用機制標題	狸藻的彈性捕蟲囊壁藉由釋放貯存的彈力能，而促成極快速的被動性吸入 (Flexible trap walls of the bladderwort allow for ultra-fast passive suction by relying on the release of stored elastic energy.)
生物系統/作用機制示意圖	 Source: https://doi.org/10.1098/rspb.2010.2292

作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)

文獻引用 (REFERENCES)

「水生性食蟲植物的狸藻屬 (*Utricularia*) 物種使用毫米大小的水中吸入型捕蟲囊 (traps) 來捕捉細小的動物獵物…抽吸由機械觸發發生，由捕蟲囊本身貯存的彈性能釋放達成能快速開啟及關閉的囊蓋 (trap door)，保持囊口關閉而防水…我們發現這種獨特的捕捉機制完成抽吸在少於一毫秒 (millisecond) 內，因此可排名已知最快的植物運動。流體加速度 (fluid acceleration) 達到非常高的值，使動物獵物只有很小機會能逃脫。我們發現囊蓋的形變是在形態上預先決定的 (predetermined)，而能確實地表現扣住/解扣的過程，包括囊蓋完全向內捲。這個過程…是高度可再現的：捕蟲囊是自動重複的，在自動觸發之後 5-20 小時，會重新活化成準備好捕捉的狀態。」(Vincent et al. 2011: 2909)

「狸藻雙凸透鏡狀的捕蟲囊…以兩階段的機制來運作。在緩慢的第一階段中…內部腺毛 (internal gland) 主動將水從捕蟲囊內部往外面泵出，由於較低的內部靜水壓力 (hydrostatic pressure)，彈性能被貯存在捕蟲囊體內，…可彎曲的囊蓋使入口保持關閉不進水，其上有凸出的觸發毛。動物獵物刺激觸發毛而激發超級快速的第二階段，藉由彈性能轉換成動能的機制而被動地進行。觸發使閥門打開，捕蟲囊壁放鬆而水分（以及獵物）因為容量突然增加而湧入捕蟲囊（圖 1c）。在閥門關上之後，獵物會被四臂腺毛 (quadrifid

glands) 所分泌的消化性酵素 (digestive enzyme) 所溶解，養分被植株所吸收。兩階段的組合形成了一個可重複的「主動性緩慢抽出水-被動性快速吸入」程序。」(Vincent et al. 2011: 2909)

"Carnivorous aquatic *Utricularia* species catch small prey animals using millimetre-sized underwater suction traps...Suction takes place after mechanical triggering and is owing to a release of stored elastic energy in the trap body accompanied by a very fast opening and closing of a trapdoor, which otherwise closes the trap entrance watertight...We found that this unique trapping mechanism conducts suction in less than a millisecond and therefore ranks among the fastest plant movements known. Fluid acceleration reaches very high values, leaving little chance for prey animals to escape. We discovered that the door deformation is morphologically predetermined, and actually performs a buckling/unbuckling process, including a complete trapdoor curvature inversion. This process...is highly reproducible: the traps are autonomously repetitive as they fire spontaneously after 5–20 h and reset actively to their ready-to-catch condition." (Vincent et al. 2011: 2909)

"The lenticular *Utricularia* trap...works with a two-phase mechanism. During the first slow phase...internal glands actively pump water out of the trap interior, so that elastic energy is stored in the trap body owing to a lower internal hydrostatic pressure...A flexible door with protruding trigger hairs closes the entrance watertight. Prey animals can stimulate these hairs and thereby launch the second, ultra-fast phase, which runs passively because of a mechanical conversion of elastic energy into kinetic energy. The triggering results in door opening, trap wall relaxation and water (and thereby prey) influx due to the sudden increase of the trap volume (figure 1c). After the door is closed, the prey is dissolved by digestive enzymes secreted by quadrifid glands, and nutrients are absorbed by the plant. Both phases together form a repeatable 'active slow deflation–passive fast suction' sequence." (Vincent et al. 2011: 2909)

參考文獻清單與連結 (REFERENCE LIST)

Vincent, O., C. Weisskopf, S. Poppinga, T. Masselter, T. Speck, M. Joyeux, C. Quilliet, and P. Marmottant. (2011). Ultra-fast underwater suction traps. *Proceedings of the Royal Society B: Biological Sciences* 278: 2909-2914. (https://doi.org/10.1098/rspb.2010.2292)

延伸閱讀

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

https://en.wikipedia.org/wiki/utricularia_inflata
https://www.onezoom.org/life/@utricularia_inflata
https://eol.org/pages/577796

撰寫/翻譯/編修者與日期

譚國鎏翻譯 (2020/09/10)；趙怡姍編修 (2021/04/20)

AskNature 原文連結
https://asknature.org/strategy/flexible-walls-allow-for-ultra-fast-passive-suction/