生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	毛毛蟲利用蟲絲改變樹葉形 (Caterpillars Reshape Leaves with Silk)
生物系統 LIVING SYSTEM	櫻桃捲葉蟲 *(Caloptilia serotinella)*
功能類別 FUNCTIONS	#永久固定　#免受動物侵害　#管理張力 #物理性組裝結構　#轉換機械能 #Attach Permanently　#Protect From Animals　#Manage Tension #Physically Assemble Structure #Transform Mechanical Energy
作用機制標題	毛毛蟲利用絲線做縫針將葉子捲成管狀庇護所。 (Caterpillars use stitches made with contracting silk threads to roll leaves into a tube-shaped shelter.)
生物系統/作用機制示意圖 (確認版權、註明出處；畫質)	 出處: https://facultyweb.cortland.edu/fitzgerald/VibrationalCommunication.html
作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)	

一種稱為噴絲頭 (spinneret) 的器官可提供強壯且有彈性的絲，可使葉片捲成管狀。櫻桃捲葉蟲藉由從葉背後咬掉一小塊葉脈，使其能更容易捲曲。

當櫻桃捲葉蟲到葉片的前端時，他們會開始從噴絲頭分泌絲。它將纖維的一端連接到葉子的尖端，另一端連接到葉下表面大約 10 mm (毫米) (半英寸）左右的上或附近的一點，在連接之前像橡皮筋一樣將纖維拉長。每根股線都會產生少量的“拉力”，且在一起作用，許多股線便會產生足夠的張力使葉子開始捲曲。

絲本身是個很好的材質。它是由蛋白質製成，一開始是液體，但能藉由碰觸空氣快速地變成雙纖維固體，約比人髮細 50 倍。

A collection of organs called spinnerets that produce a stretchy, strong silk that can exert a force strong enough to roll the leaf into a curl. Crawling along the underside of a leaf, biting chunks out of the tough vein that runs down the middle to allow it to be more easily rolled up.

When it gets to the tip of the leaf, the caterpillar starts to extrude silk from its spinnerets. It attaches one end of the fiber to the tip of the leaf and the other to a point on or near the underside of the leaf some 10 millimeters (a half-inch) or so away, stretching the strand out like a rubber band before attaching. Each strand creates a tiny amount of “pull,” and together, many strands create enough tension to cause the leaf to start to curl.

The silk itself is an amazing substance. Made from proteins, it starts as a liquid but quickly turns into a double fiber about 1/50 the diameter of a human hair when it hits air.

文獻引用 (REFERENCES)

運用樹葉建造出庇護所的建築師通常不是直接改變樹葉形態，而是利用它們的絲縫合樹葉。儘管人們通常認為新紡絲的干燥會導致其收縮，並且在此過程中會產生操縱葉子所需的力，但事實並非如此。建造葉子庇護所的毛毛蟲通在紡絲時，將它們拉伸到超出平衡長度的方式，將潛能傳遞到絲線。拉伸的絲線之軸向的縮回 (retraction) 能使葉表已黏合絲線的植物葉片拉到一起。儘管單一根拉伸的絲線僅能施加很小的力量，但由許多這樣的絲線連接到相同對面向的葉表 (the same opposable plant surfaces) 所產生的合力則是巨大的，如此可使毛蟲能操縱比它身體大許多倍的葉片和質量。

Leaf shelter-builders do not manipulate leaves directly but use their silk to draw plant surfaces together. Although it has often been assumed that drying of newly spun silk causes it to shrink and, in the process, to generate the forces needed to manipulate leaves showed that this is not the case. Leaf shelter-building caterpillars impart potential energy to their silk strands by stretching them beyond their equilibrium length as they are spun out.
Axial retraction of the stretched strands then draws the bound plant surfaces together. Although a single stretched strand exerts only a minuscule force, the combined force generated by many such strands attached to the same opposable plant surfaces is substantial and allows the caterpillars to manipulate leaves many times their size and mass. (Fitzgerald & Clark 1994)

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

T.D. Fitzgerald & K.L. Clark(1994): Journal of Insect Behavior

延伸閱讀: Harvard 或 APA 格式（取自 AskNature 原文；若為翻譯者補充，請註明）
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撰寫/翻譯/編修者與日期
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