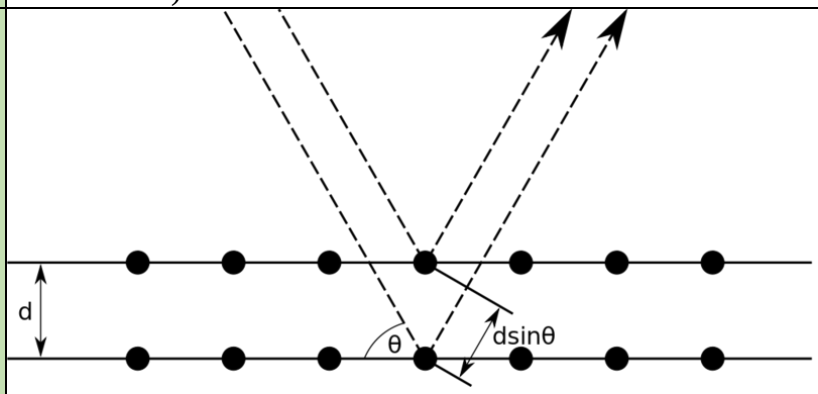
生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	有著亮藍色點彩外觀的果皮 (Fruit skin has bright blue pointillist appearance)
生物系統 LIVING SYSTEM	大理石漿果 (杜若屬) *Pollia condensate* (Marble berry)
功能類別 FUNCTIONS	#改變光線/顏色 #傳遞光訊號（可見光譜） #Modify light/color #Send light signals in the visible spectrum
作用機制標題	大理石漿果的果皮因為纖維素微纖維上有明顯細胞至細胞間布拉格反射作用而有明亮的藍色點彩外觀 (The skin of the marble berry has a bright blue pointillist appearance due to distinct cell-to-cell Bragg reflection of color on cellulose microfibrils)
生物系統/作用機制示意圖	 

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

文獻引用 (REFERENCES)

"藉助結構色進行的生物性溝通已經存在了至少五億年了。結構色在動物界中普遍可見，但在植物的研究卻很少。我們提供了一個植物中突出的例子，來自杜若屬 *Pollia condensata* 大理石漿果由多層結構造成強烈虹光 (iridescent) 色彩的果實。這種顏色是產生自外果皮 (epicarp) 細胞壁中形成多層構造的螺旋狀堆疊之纖維素微纖維 (cellulose microfibrils) 所造成的布拉格反射現象 (Bragg reflection)。我們證明了動物與植物之間趨同演化 (convergently evolved) 出多層次的光學結構，使用完全不同的材料來產生色彩。這種果實的明亮藍色色彩比起以往描述過的任何生物材料都要強烈。這是自然中獨一無

二的，隨著多層堆疊構造中層次厚度的變化，在細胞與細胞之間反射的色彩變得不一，而使果實有著引人注目如馬賽克般 (pixelated) 或點彩的 (pointillist) 外觀。由於多層構造形成兩種螺旋結構 (helicoidicities)，其光學特性展現出從每個表皮細胞反射光都向左或向右圓偏振 (polarized circularly)，這是以往從未在單一組織中被觀察過的一個特徵。(Vignolini 2012: 15712)

"Biological communication by means of structural color has existed for at least 500 million years. Structural color is commonly observed in the animal kingdom, but has been little studied in plants. We present a striking example of multilayer-based strong iridescent coloration in plants, in the fruit of *Pollia condensata*. The color is caused by Bragg reflection of helicoidally stacked cellulose microfibrils that form multilayers in the cell walls of the epicarp. We demonstrate that animals and plants have convergently evolved multilayer-based photonic structures to generate colors using entirely distinct materials. The bright blue coloration of this fruit is more intense than that of any previously described biological material. Uniquely in nature, the reflected color differs from cell to cell, as the layer thicknesses in the multilayer stack vary, giving the fruit a striking pixelated or pointillist appearance. Because the multilayers form with both helicoidicities, optical characterization reveals that the reflected light from every epidermal cell is polarized circularly either to the left or to the right, a feature that has never previously been observed in a single tissue." (Vignolini 2012: 15712)

參考文獻清單與連結 (REFERENCE LIST)

Vignolini, S., P. J. Rudall, A. V. Rowland, A. Reed, E. Moyroud, R. B. Faden, J. J. Baumberg, B. J. Glover, and U. Steiner. (2012). Pointillist structural color in *Pollia* fruit. *PNAS* 109: 15712-15715. (https://www.pnas.org/content/109/39/15712)

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/pollia_condensata
https://www.onezoom.org/life/@pollia_condensata
https://eol.org/pages/247618

撰寫/翻譯/編修者與日期

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AskNature 原文連結

https://asknature.org/strategy/fruit-skin-has-bright-blue-pointillist-appearance/