

移動城堡

The Moving Castle

具內骨骼，這些骨骼通常都支撐著一些突起，使得棘皮動物有許多棘刺狀外觀。

Echinoderms possess an internal skeleton that supports various protrusions, giving them their characteristic spiny appearance.

棘皮動物約有 7,600 種，是「純海生」動物最大的一「門」。

The phylum Echinodermata, which includes around 7,600 species, is the largest group of exclusively marine animals.

鰓囊收縮時可將水壓入管足使其伸長；相反，若鰓囊擴張，水回流其中，則管足縮短收回。

When the ampulla contracts, it pushes water into the tube feet, causing them to extend. Conversely, when the ampulla expands, water flows back into it, and the tube feet shorten and retract.

水流方向

管足伸縮方向

Direction of Water Flow

Direction of Tube Foot Extension and Retraction

瓣膜 - 由於有瓣膜防止逆流，所以每個管足可獨立伸縮。

The water moves from the ampulla into the tube feet when extending, and flows back into the ampulla when retracting.

水管系統大揭密

The Water Vascular System Unveiled

水管系統是棘皮動物所特有，透過水壓調節相對封閉的管狀系統，負擔著多種生理功能。

The water vascular system is unique to echinoderms. It operates through water pressure to regulate a relatively closed system of tubes, which perform various physiological functions, such as movement, feeding, and respiration.

捕食

可藉由吸附和施加壓力撬開貝類的外殼

Predation

Echinoderms can pry open the shells of mollusks by applying suction and pressure with their tube feet.

感知環境

可以感知化學信號和物理信號

Response to the environment

Echinoderms are sensitive to both chemical signals and physical signals in their surroundings.

鰓囊、管足、側水管、輻水管、篩板、石管、環水管

Ampulla, Tube Feet, Lateral Canal, Radial Canal, Madreporite, Stone Canal, Ring Canal

環水管、輻水管、側水管、鰓囊

Ring canal, Radial canal, Lateral canal, Ampulla

吸盤黏黏看！

Try Attaching the Suction Cups!

管足真的是用「吸」的嗎？

Tube Feet: Do They Really “Suck” ?

未附著時、附著時、附著處染色

從上圖可知，吸附處並未形成真空帶，有許多橫向路徑（箭頭），雖然每種棘皮動物的狀況皆有些許的不同，但是

Before Attachment, During Attachment, After Attachment (Dyed Section)
From the images, it is clear that no vacuum is formed at the attachment point. Instead, there are many lateral pathways (as indicated by arrows). Although the specific mechanism varies slightly between different echinoderm species, the general principle remains the same—adhesion is achieved through these lateral pathways and sticky secretions, rather than through vacuum-based suction.

實驗 1

壓

繩子拉扯的方向皆需相同！

體驗看看兩者「吸」力是否相同？

吸盤

洞

研究數據顯示，不同表面下管足扯下的力沒有統計上的差異。

Experiment 1

Press

The direction of the rope pull must be the same!

Test whether the suction force is the same for both cases?

Suction cup

Hole

Research data shows that there is no statistically significant difference in the force required to pull off the tube feet on different surfaces.

實驗 2

壓

繩子拉扯的方向皆需相同！

體驗看看兩者「吸」力是否相同？

研究數據顯示，不同角度下管足扯下的力沒有統計上的差異。

Experiment 2

Press

The direction of the rope pull must be the same!

Test whether the suction force is the same for both cases?

Research data shows that there is no statistically significant difference in the force required to pull off the tube feet at different angles.

所以你覺得管足的吸力最主要是來自「吸」嗎？

So, do you think the main force of the tube feet comes from “suction” ?