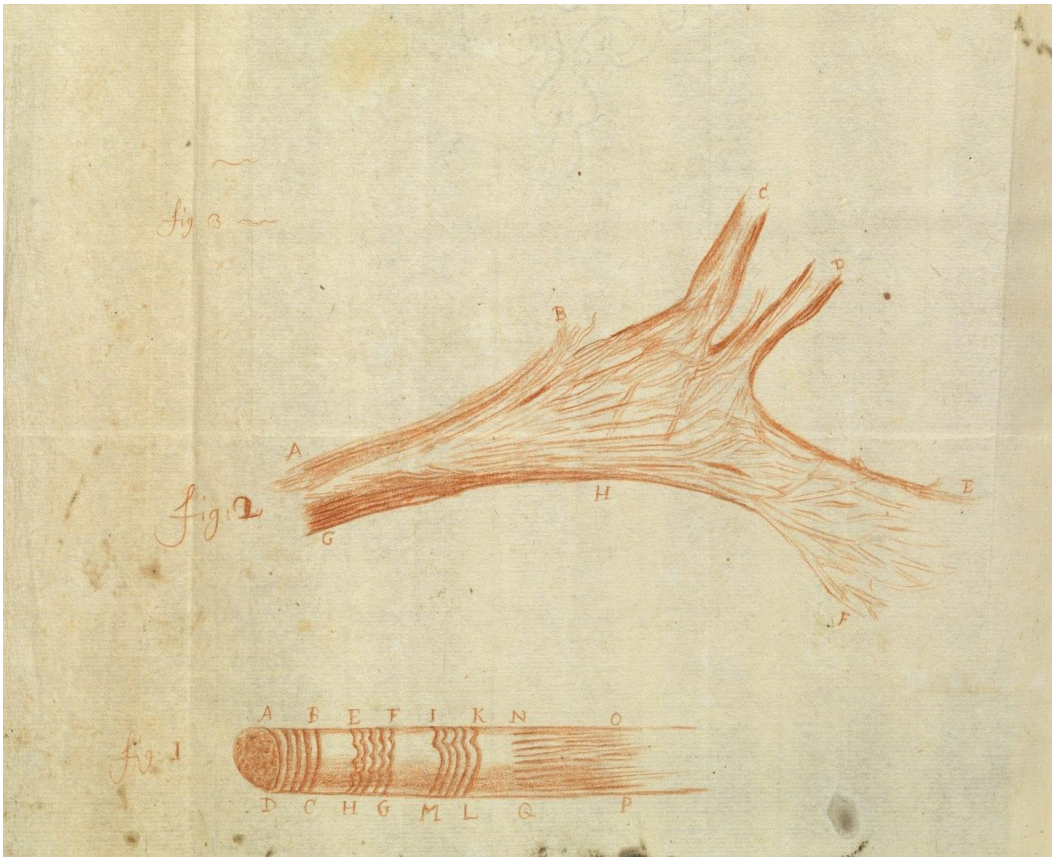
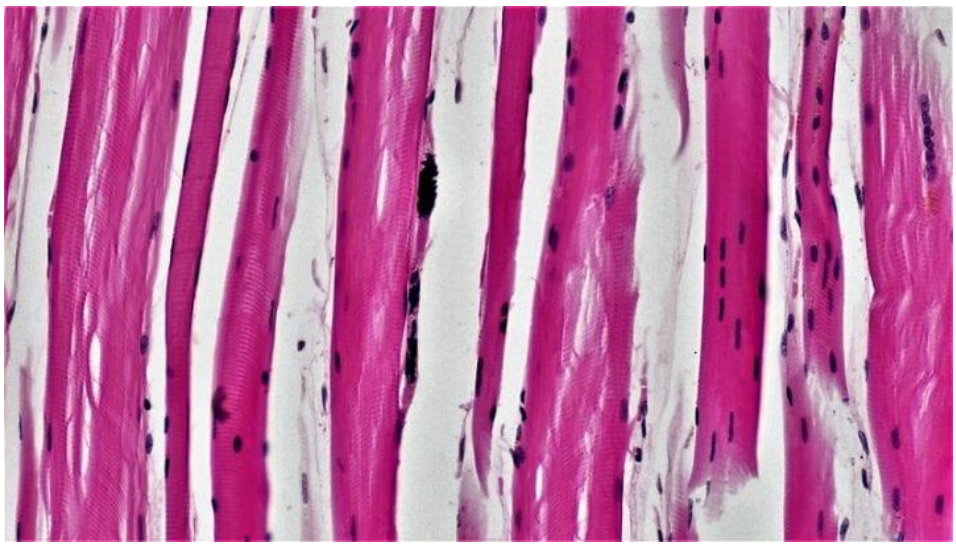
生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	骨骼肌產生力量 (Skeletal Muscles Generate Force)
生物系統 LIVING SYSTEM	脊椎動物（哺乳類，魚類，鳥類，爬蟲類） Vertebrates (Mammals, Fish, Birds, Reptiles)
功能類別 FUNCTIONS	#在固體中/上移動 #調節細胞代謝 #改變位置 #move in/out solid #regulate cellular process #modify size/shape/mass/volume #modify position
作用機制標題	骨骼肌收缩和放鬆，產生力量，使其移動 (Skeletal muscles contract and relax, generating force and enabling movement.）
生物系統/作用機制示意圖 (確認版權、註明出處；畫質)	



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

我們現在將這些細絲稱為肌原纖維 (myofibril)。數以千計的肌原纖維組成一條肌肉纖維，就像小稻草堆放在一起成爲更大的稻草堆一樣。每個肌原纖維被分成圓柱形部分 (cylindrical section)，彼此堆疊並連接在一起。

這些結構被稱為肌節 (sarcomere)，它們是肌肉中最小的收縮元素。當你彎曲你的二頭肌時，神經會釋放化學物質，這些化學物質會引發肌節像扁平的汽水罐一樣向內擠壓，從而縮短肌原纖維。這會拉動和收縮肌肉纖維，從而使整個肌肉彎曲。本質上，肌肉收縮是其肌節收縮的總和

單個肌節通過稱為“滑行細絲理論 (the sliding filament theory)”的過程來縮短自身。肌節主要由兩種蛋白質組成：肌動蛋白和肌球蛋白。肌動蛋白形成細絲，從圓柱形肌節的兩個扁平端向中心延伸而沒有連接，就像帶有不接觸架子的相對壁一樣。在每個肌動蛋白絲之間，粗大的肌球蛋白絲橫跨大部分肌節。化學變化導致肌球蛋白與肌動蛋白結合併將“架子”向內拉，使肌節從兩側收縮。

當肌肉放鬆時，就會發生相反的情況。肌球蛋白釋放肌動蛋白 (actin)，支架向外滑動，拉長肌節、肌原纖維，最終拉長肌肉本身。滑動的蛋白質細絲使我們能夠在肌肉中產生力量，從而使我們能夠進行諸如跑步、游泳、在 17 世紀時通過顯微鏡觀察或在 21 世紀時在電腦上打字等工作。

We now know these filaments as myofibrils. Thousands of myofibrils make up a single muscle fiber like tiny straws stacked inside a much larger one. Each myofibril is divided into cylindrical sections stacked on top of one another and linked together.

These structures are called sarcomeres, and they’re the smallest contracting elements of a muscle. When you decide to flex your biceps, nerves release chemicals which trigger the sarcomeres to squish themselves inward like flattened soda cans, which shortens the myofibrils. This pulls and contracts the muscle fibers, which flexes the entire muscle. In essence, a muscle contraction is the sum of its sarcomere contractions.

A single sarcomere shortens itself through a process called “the sliding filament theory.” Sarcomeres are made primarily of two proteins: actin and myosin. Actin proteins form thin

filaments that extend from both flat ends of the cylindrical sarcomere towards the center without connecting, like opposite walls with shelves that don't touch. In between each actin filament, thick myosin filaments stretch across most of the sarcomere. Chemical changes cause myosin to bind with actin and pull the "shelves" inward, shrinking the sarcomere from both sides.

When muscles relax, the reverse occurs. Myosin lets go of the actin, and the shelves slide outward, elongating the sarcomere, myofibrils, and eventually the muscle itself. Sliding protein filaments enable us to generate force in our muscles that allows us to do work like running, swimming, looking through a microscope in the 17th century, or typing on a computer in the 21st.

文獻引用 (REFERENCES)

骨骼肌是人體最具活力和可塑性的組織之一。在人類中，骨骼肌約佔總體重的 40%，並含有所有身體 50–75% 的蛋白質。一般來說，肌肉質量取決於蛋白質合成和降解之間的平衡，這兩個過程都對營養狀況、荷爾蒙平衡、身體活動/鍛煉、損傷或疾病等因素敏感。在這篇綜述中，我們討論了肌肉結構和功能的各個領域，包括其細胞骨架結構、興奮-收縮耦合、能量代謝以及力量和能量的產生。我們將把討論限制在人體骨骼肌上，並強調最近關於單肌纖維的科學文獻。

Skeletal muscle is one of the most dynamic and plastic tissues of the human body. In humans, skeletal muscle comprises approximately 40 % of total body weight and contains 50–75 % of all body proteins. In general, muscle mass depends on the balance between protein synthesis and degradation and both processes are sensitive to factors such as nutritional status, hormonal balance, physical activity/exercise, and injury or disease, among others. In this review, we discuss the various domains of muscle structure and function including its cytoskeletal architecture, excitation-contraction coupling, energy metabolism, and force and power generation. We will limit the discussion to human skeletal muscle and emphasize recent scientific literature on single muscle fibers.

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

Skeletal Muscle: A Brief Review of Structure and Function Calcified Tissue International | Walter R. Frontera and Julien Ochala（https://link.springer.com/article/10.1007/s00223-014-9915-y）

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

撰寫/翻譯/編修者與日期

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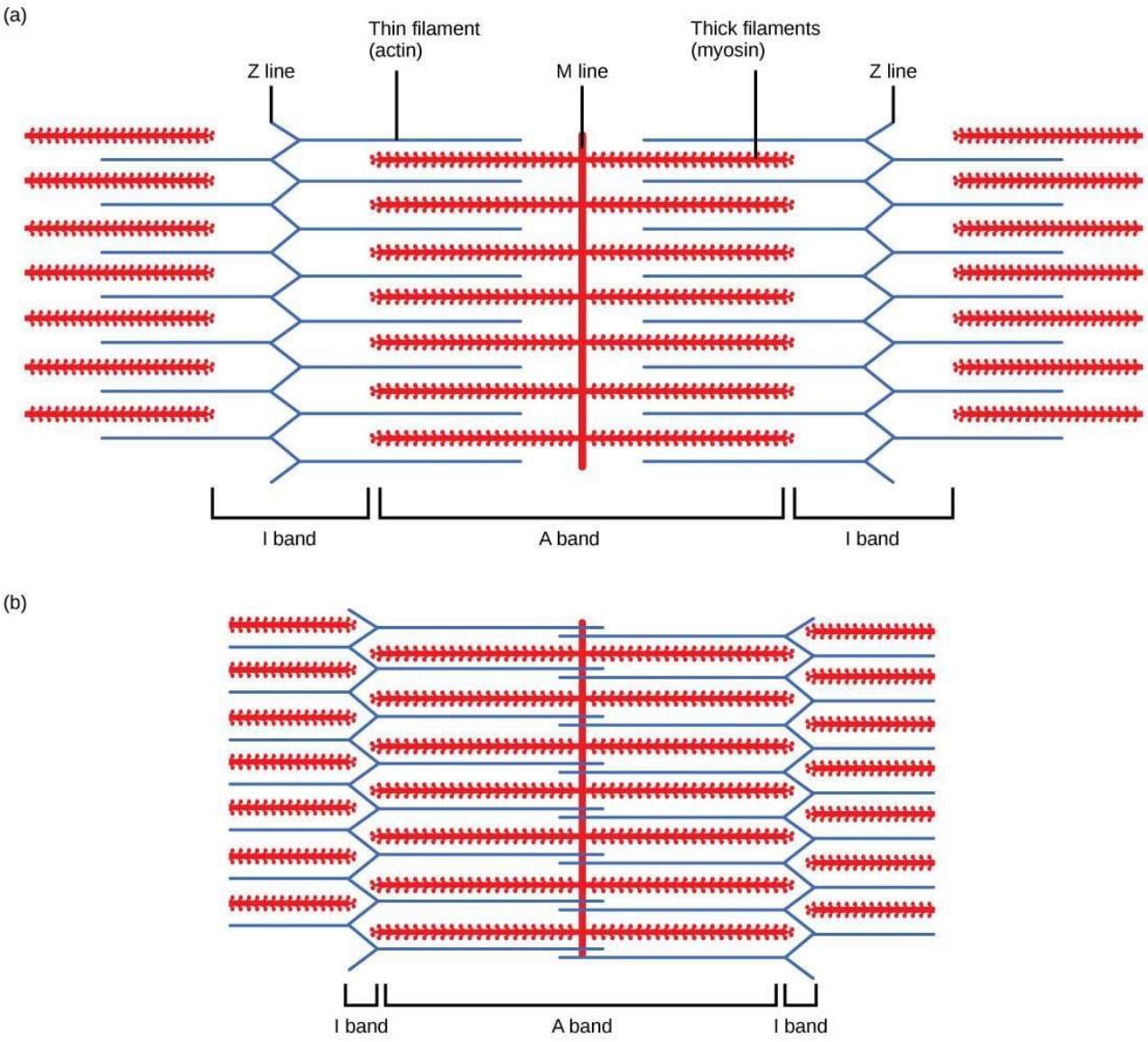

(a) 示放鬆的肌節狀態，(b) 顯示一個收縮的肌節，很細的肌動蛋白絲被粗肌球蛋白絲拉向中心。