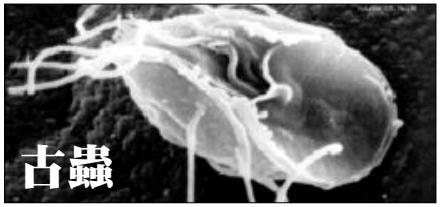
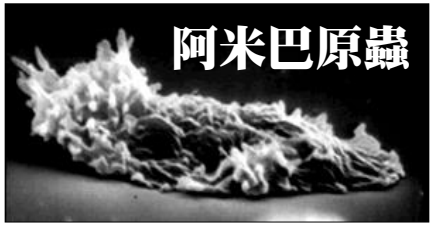
真核細胞

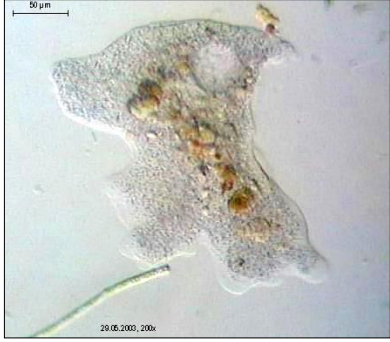
Profiles of Nature: 簡單的真核生物

水塘中的微小生物

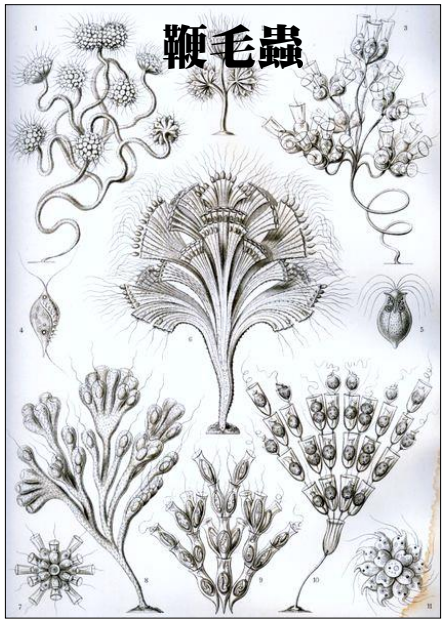


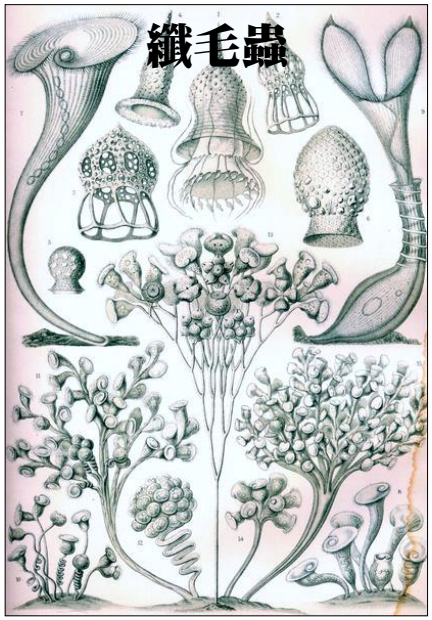


基本性 vs 多樣性

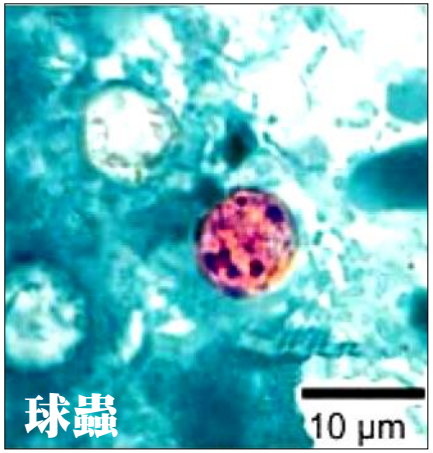


原生生物：最簡單的真核細胞





真核細胞在構造與功能上，比原核細胞複雜。



真核細胞真的有一個細胞核，還有細胞質內的許多細胞器官 (胞器)。

http://www.bms.ed.ac.uk/research/others/smaciver/amoebae.htm

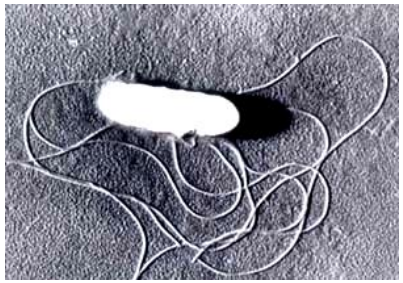
C41a

WIKIPEDIA

Discovery CHANNEL

真核細胞

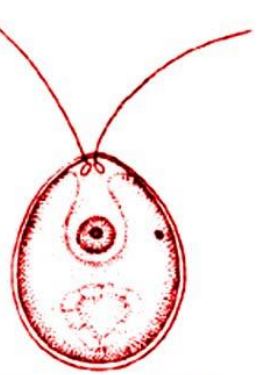
由原核到真核，由單細胞到多細胞



(環狀 DNA)

由原核到真核

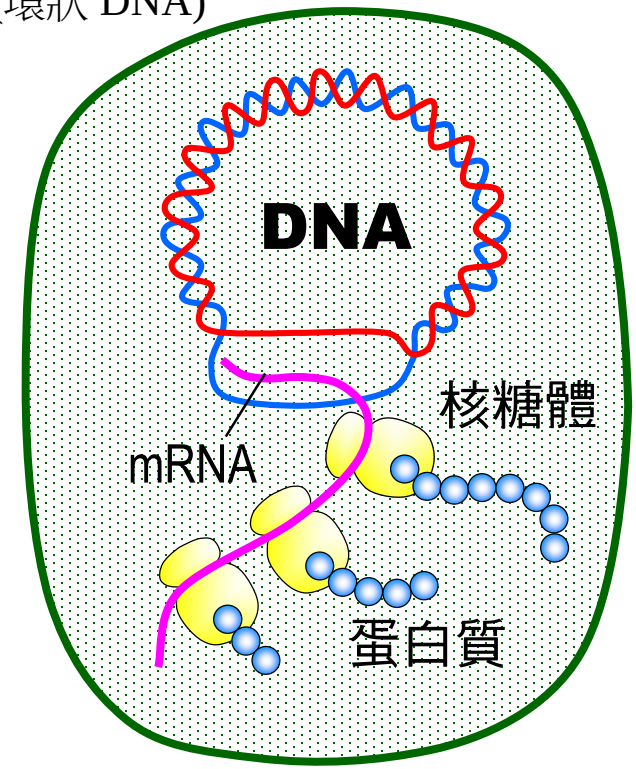
細胞核生成、胞器加入

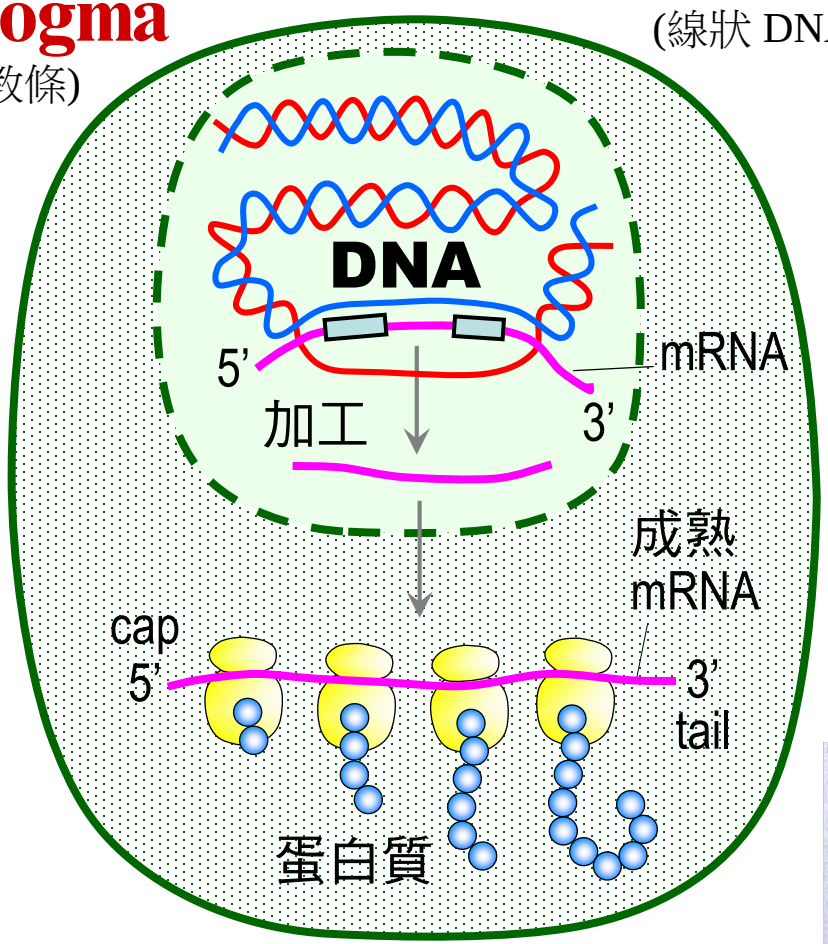


Central Dogma

(生物學中心教條)

(線狀 DNA)



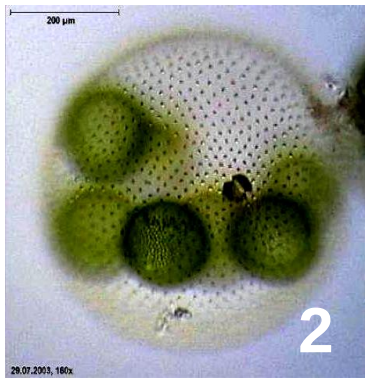


由單細胞到多細胞

細胞聚集、分工、調節

原核細胞 (單身宿舍)

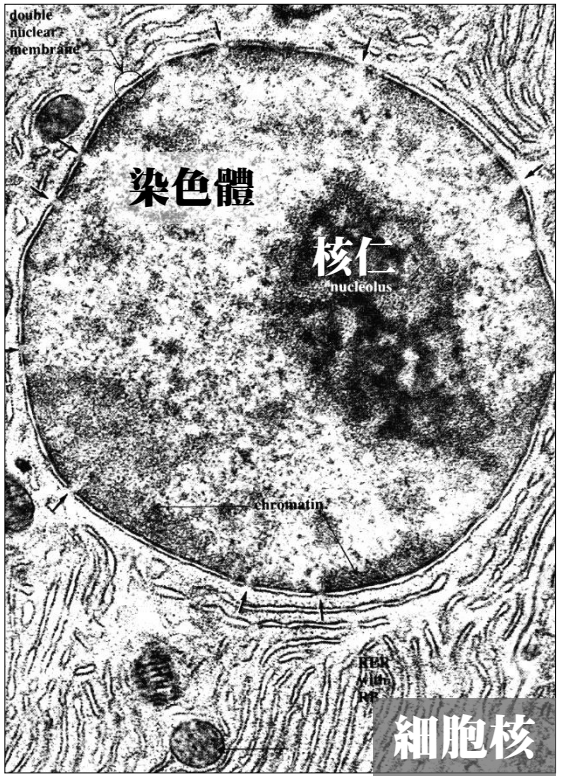
真核細胞 (三房兩廳)

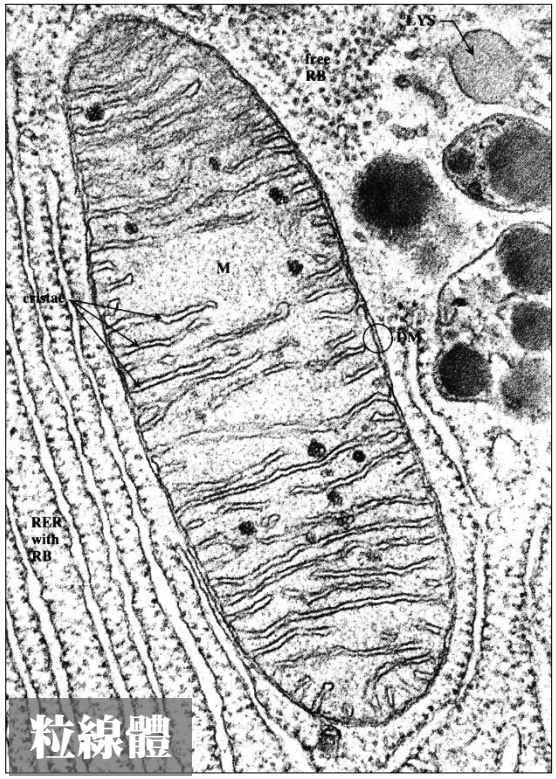


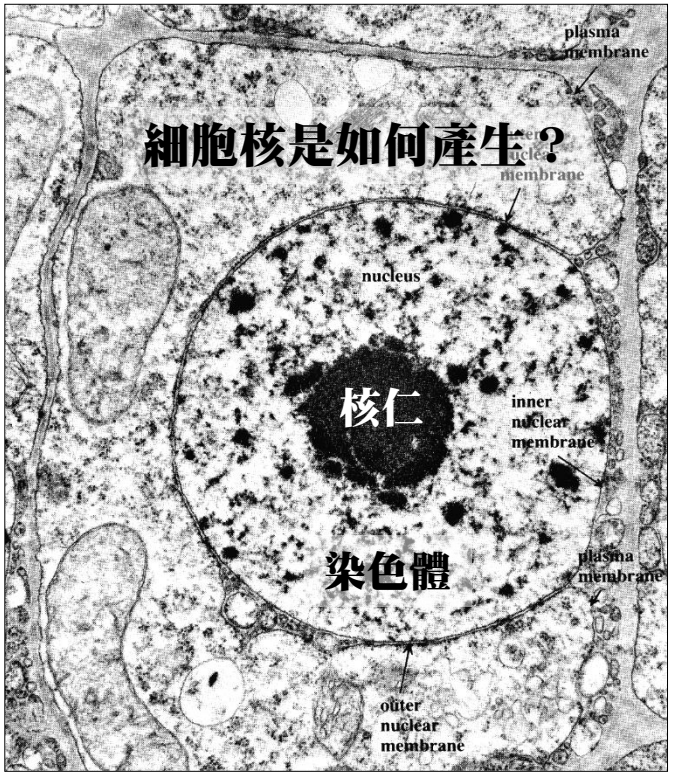
WIKIPEDIA micro*scope

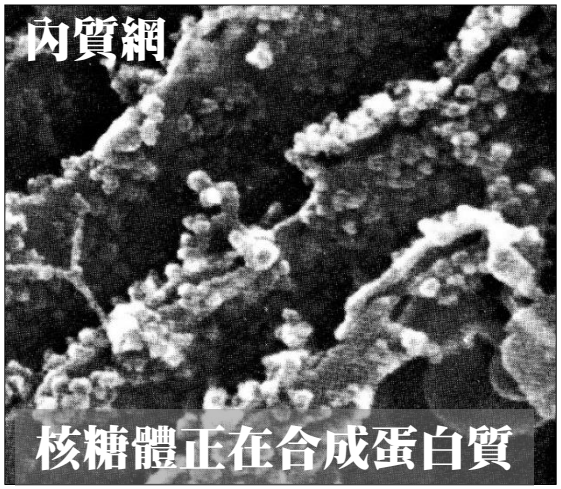
真核細胞

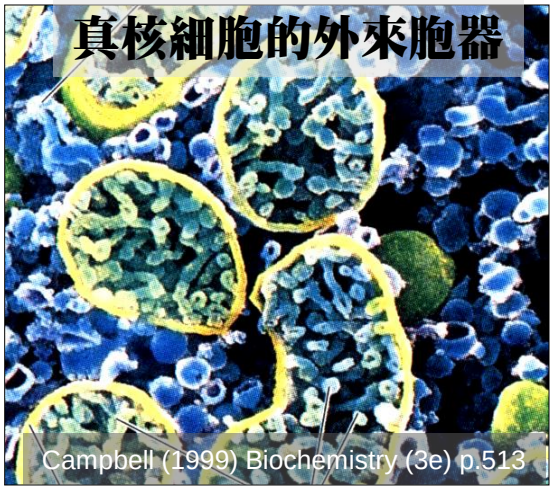
真核細胞的主要特徵就是細胞核及許多胞器



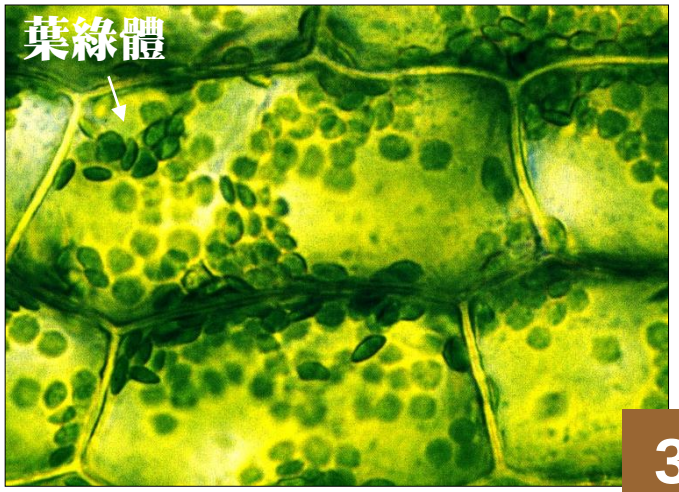








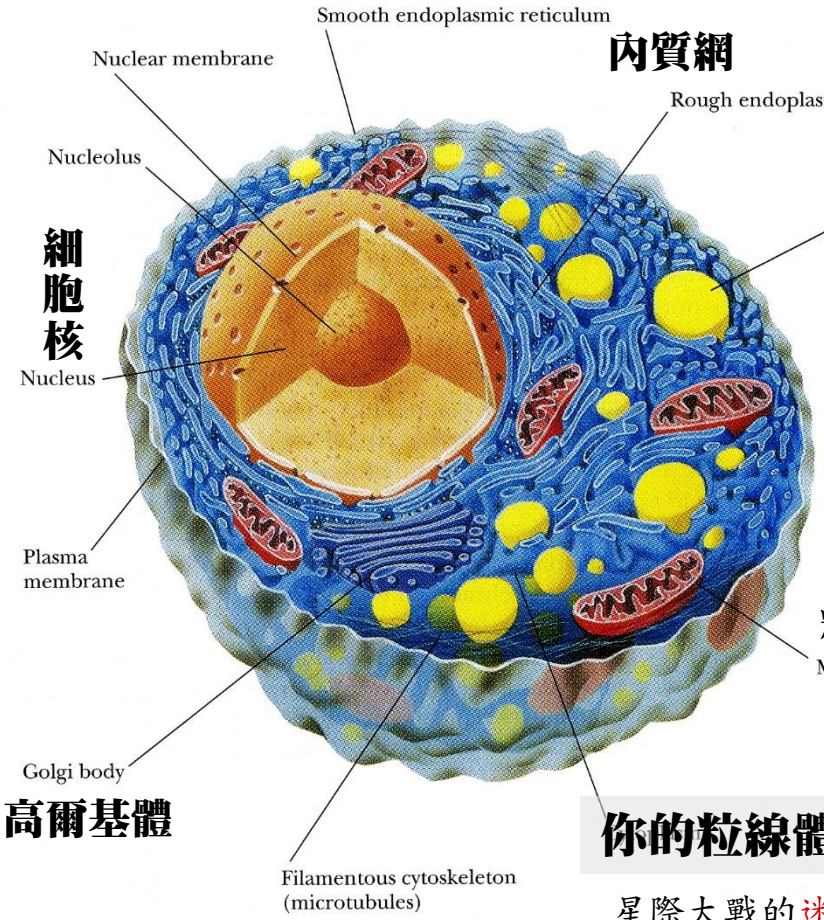
Campbell (1999) Biochemistry (3e) p.513

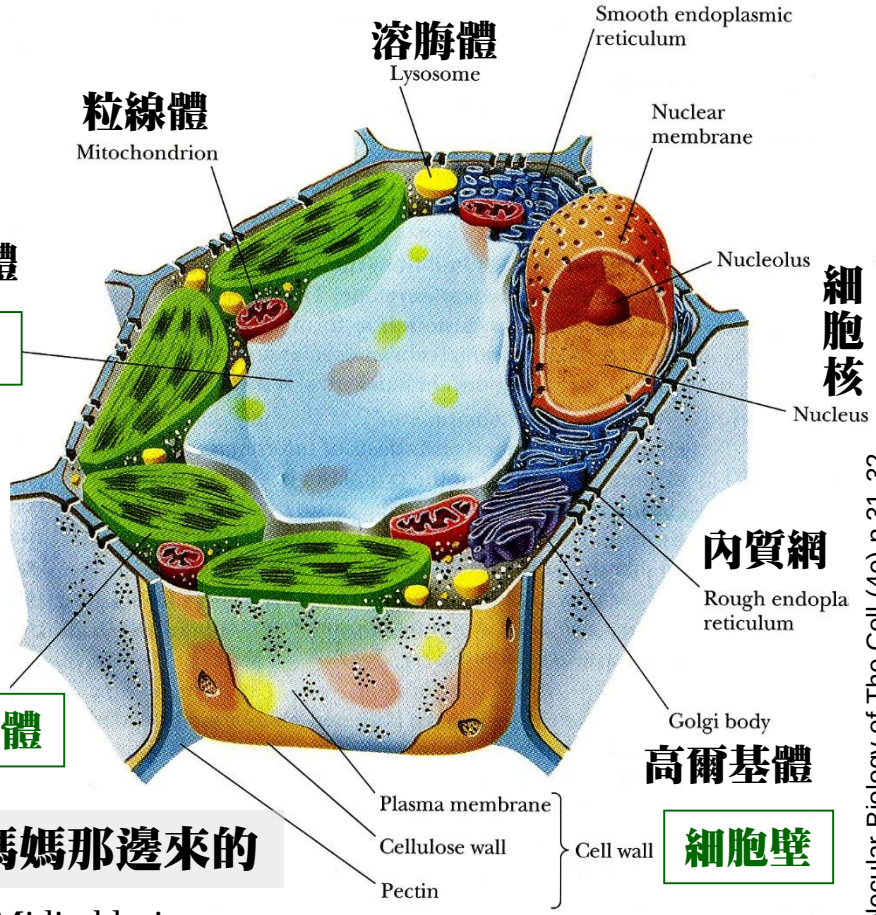


Bohinski (1987) Modern Concepts in Biochemistry (5e) p.19-26

真核細胞

動植物細胞之比較與外來胞器 (粒線體、葉綠體)



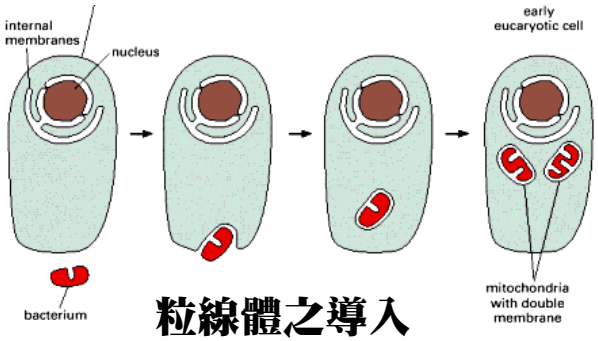


Garrett & Grisham (2005) Biochemistry (3e) p.24-25

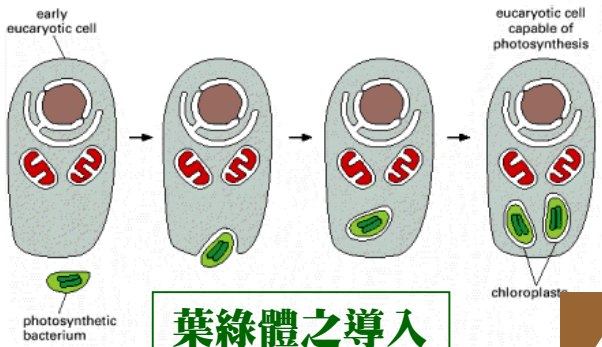
Alberts et al (2002) Molecular Biology of The Cell (4e) p.31-32

你的粒線體只有媽媽那邊來的

星際大戰的迷地原蟲 Midi-chlorians



粒線體之導入



葉綠體之導入

Q1 以下何者不是『胞器』？

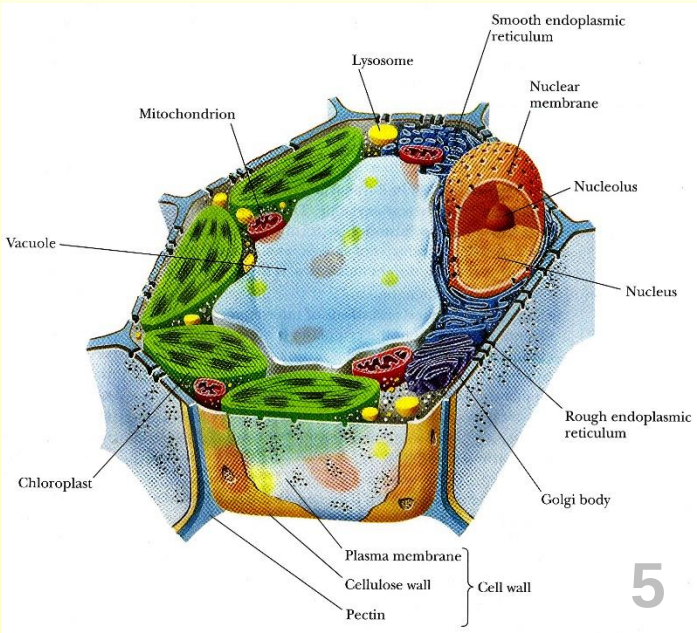
(1) 細胞核

(2) 細胞壁

(3) 粒線體

(4) 葉綠體

(5) 內質網



(2)

Q2 以下何者不含核酸 DNA？

(1) 細胞膜
(2) 細胞核
(3) 粒線體
(4) 葉綠體
(5) 大腸菌

(1)

假如把地球上的細胞分成兩大類，可以如何分法？

『原核細胞、真核細胞』

真核細胞真的有一個細胞核。還可能有其他什麼胞器？

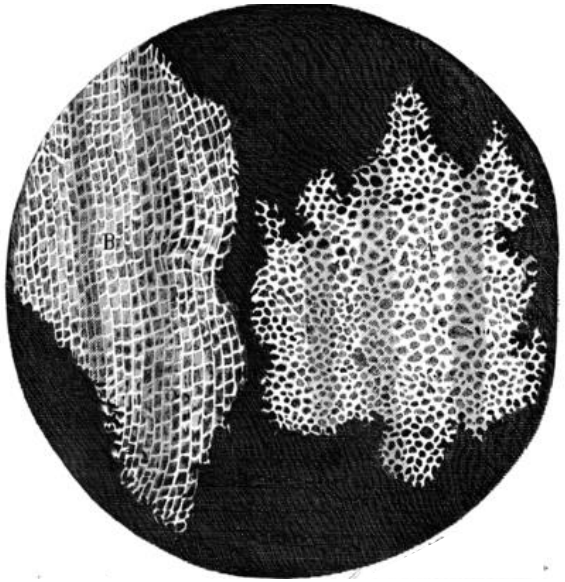
『粒線體、葉綠體、內質網、高氏體』

粒線體與葉綠體兩者有何異同？

『都是外來者與細胞內能量獲取有關』
『葉綠體只出現在植物細胞中』

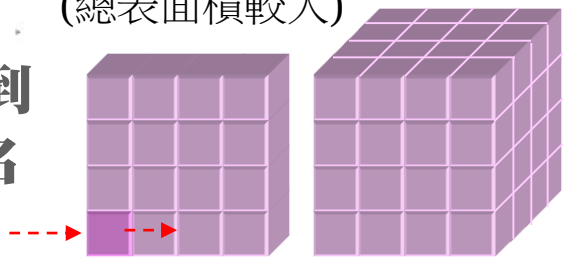
真核細胞

細胞的體積通常都很小，要用顯微鏡才看得到



1663 英國人 Hook 看到軟木塞的細胞壁，取名 cell (像地窖)。

主要原因是，在相同體積中，細胞分得越細、越小，就會有最大表面積；而物質進出細胞的路徑會比較短，吸收效率較高。



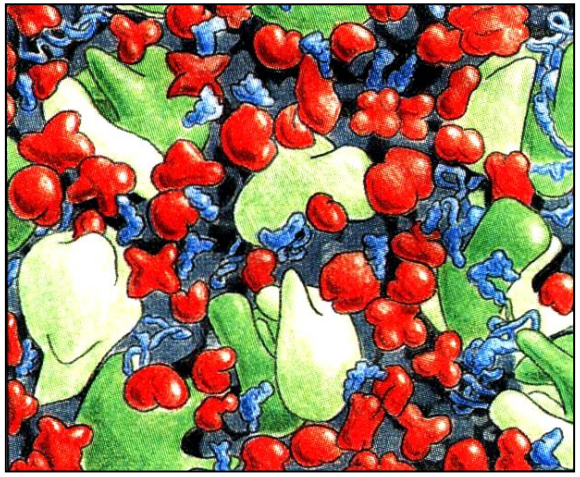
組合多細胞

(總體積相同)

單一大細胞

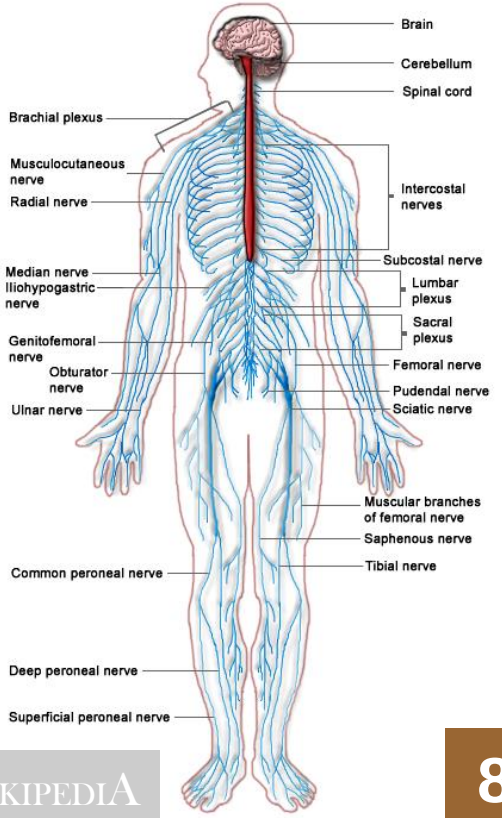
蕨藻是世界上最大的單細胞生物，可達數公尺高。

細胞裡面非常擁擠



Alberts et al (2002) Molecular Biology of the Cell (4e) p.78, 99

神經細胞都很長

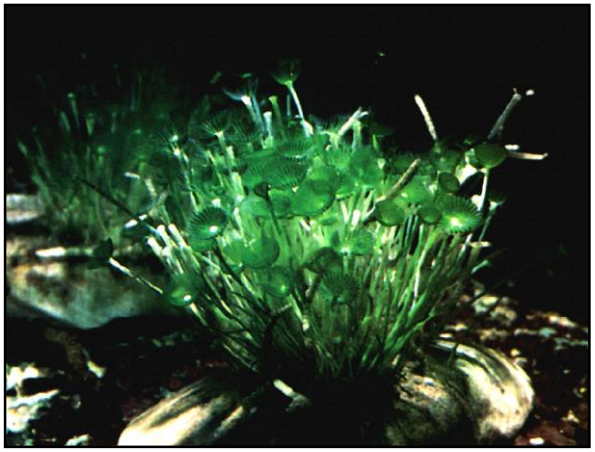


WIKIPEDIA

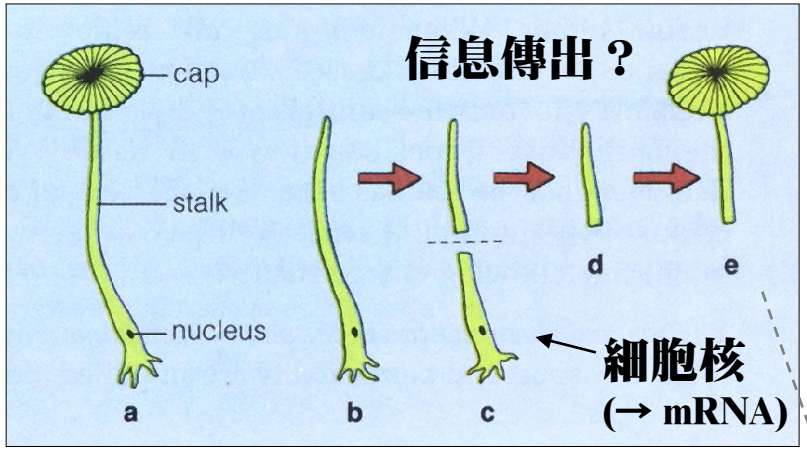
http://www.brookscole.com/biology_d/templates/student_resources/0030270448_tobin/webbit/ch04-01.html

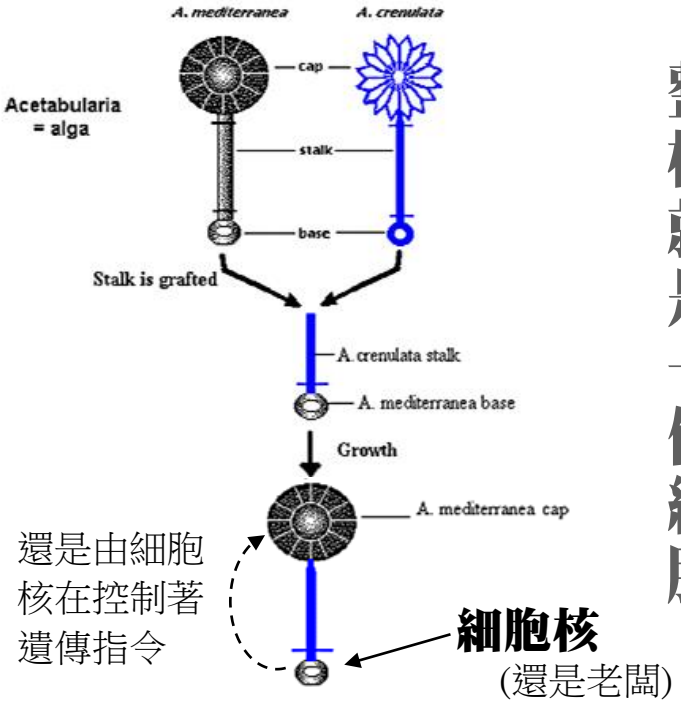
真核細胞

臺灣原生之單細胞生物大傘藻，是研究的好材料



Starr & Taggart (1987) Biology (4e) p.225





還是由細胞核在控制著遺傳指令

ACCESS EXCELLENCE @ the national health museum RESOURCE CENTER

大傘藻 *Acetabularia*

algaeBASE

整株就是一個細胞

Q3 為何單一細胞的體積都很小？

(1) 許多細胞組成個體後總表面積較大
(2) 可像更換零件一樣分別替換各細胞
(3) 內部分子要擴散到外面的速度較快
(4) 所需的組成物質較少因而比較經濟
(5) 由許多小細胞組成個體後可以分工

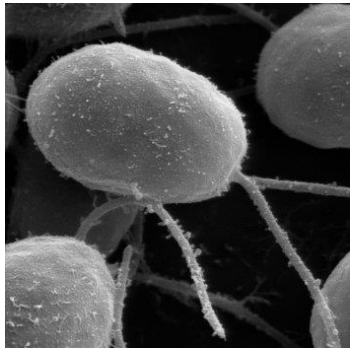
較不恰當的答案？

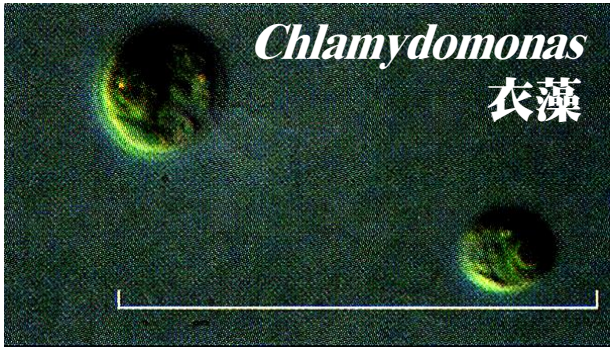
(4)

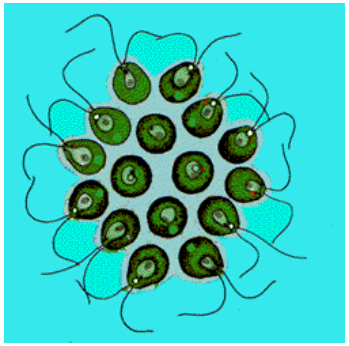
真核細胞

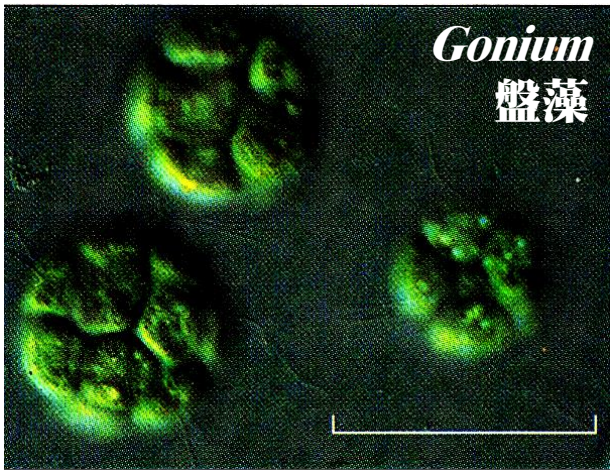
由單細胞到多細胞，生物可分工以增加生存優勢

(1) **衣藻**只有單細胞，有點像帶有鞭毛的原蟲，只是含有葉綠體。



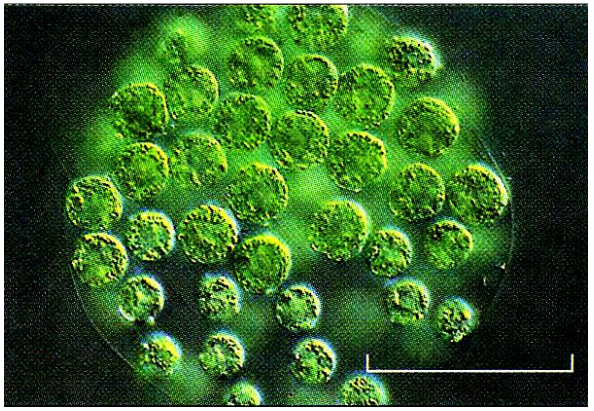


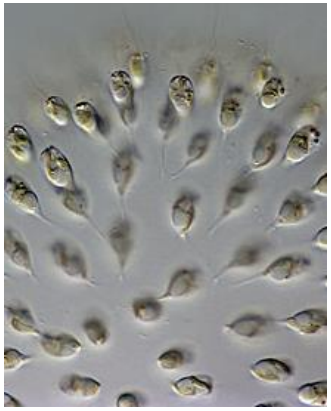


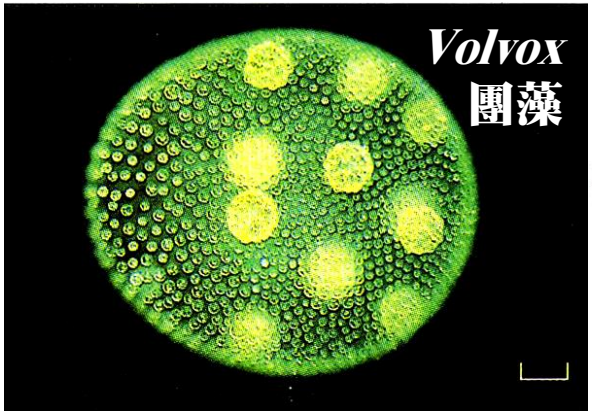


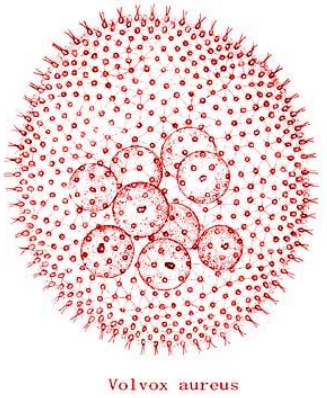
(2) **盤藻**集合 4 到 32 個細胞，群體過活，可以一起以鞭毛同向滑水，但還是獨立個體，各自分裂生殖。

(3) 更大群落聚集成空心球稱團藻，較原始者每個細胞仍可獨立生活。









(4) **團藻**的每個細胞間，有架橋物質連結，**無法單獨生存，具生理上的分工**，球內的細胞負責生殖。

Alberts et al (1994) Molecular Biology of the Cell (3e) p.27

大部分生物細胞都很小，為什麼？

『物質進出較快、總表面積較大』

假如把人變成只有單一個細胞構成，有沒有可能？ 你願不願意？

『幾乎不可能』

細胞核有何重要功能？

『貯藏遺傳信息、控制細胞活動』

許多細胞聚集在一起生活有何好處？

『成員開始分工、執行複雜活動』

關鍵名詞

原核細胞 prokaryote
真核細胞 eukaryote
胞器 organelle
細胞核 nucleus
粒線體 mitochondria
葉綠體 chloroplast
內質網
高爾基體 Golgi

單細胞
蕨藻
大傘藻
多細胞
分工
衣藻
盤藻
團藻

Central Dogma

(中心教條)

DNA
↓ 轉錄
RNA
↓ 轉譯
蛋白質
[核糖體]

Discussion 討論問題

(1) 比較真核細胞與原核細胞的異同，自然界為何存在著這兩種細胞？

(2) 非常驚嘆粒線體是被吞入的原始細菌，如何證明這是真的？

(3) 粒線體與葉綠體有何異同之處？假如動物也有葉綠體，會產生什麼結果？

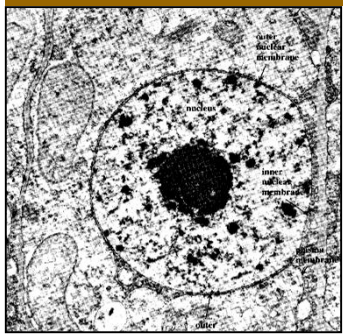
(4) DNA 轉錄成 mRNA 後要送出細胞核去轉譯蛋白質，為何要如此麻煩？

(5) 為何細菌沒有各種胞器也活得好好的？

細胞、分子與人類

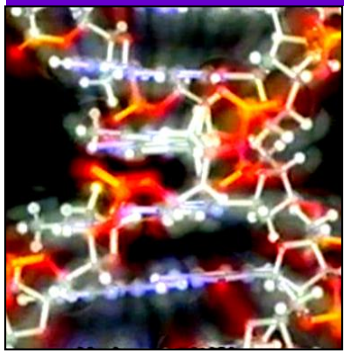
上課進度一覽

真核細胞



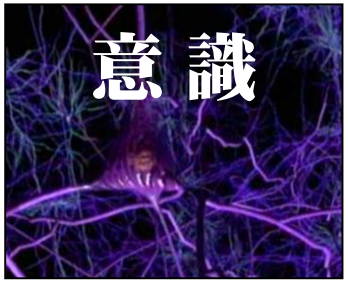
- **C41 細胞、組織、代謝**
  - C41a 水塘生物
  - C41c 肌肉與骨骼
  - C41d 肝臟
- **C42 基因遺傳**
  - C42a 記憶
  - C42b 蒼蠅王
- **C43 胚胎成長發育**
  - C43a 誕生
  - C43b 創世紀
- **C44 分子生物學**
- **S40 核酸**

生物科技



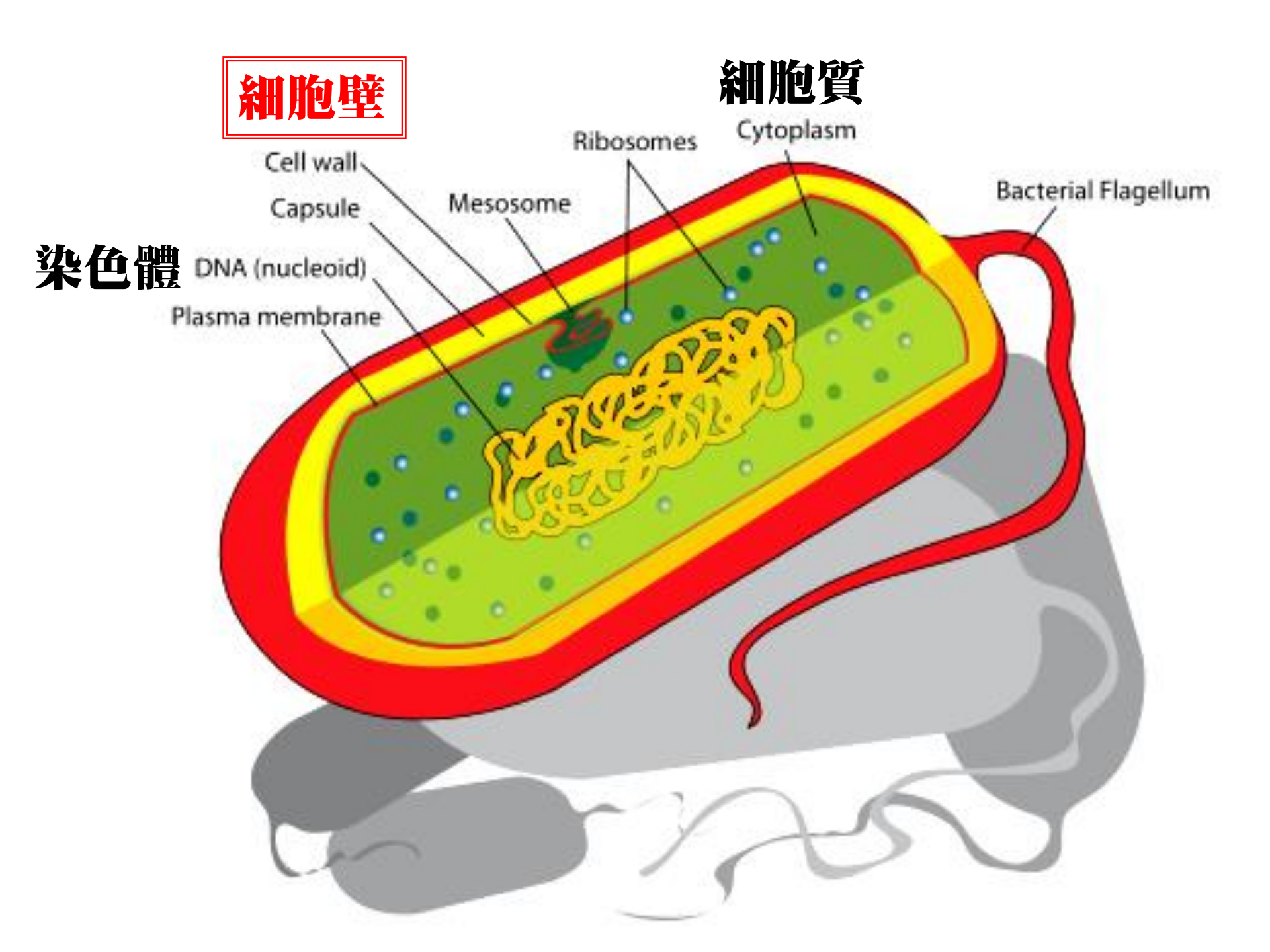
- **C51 打開潘朵拉的盒子**
- **C52 有用生物科技**
  - C52a 基因偵探
  - C52b 海洋生物寶藏
- **C53 對社會與環境的影響**
- **C54 回顧 DNA 時代**
  - C54 DNA 時代 1~6
- **S50 生物技術**

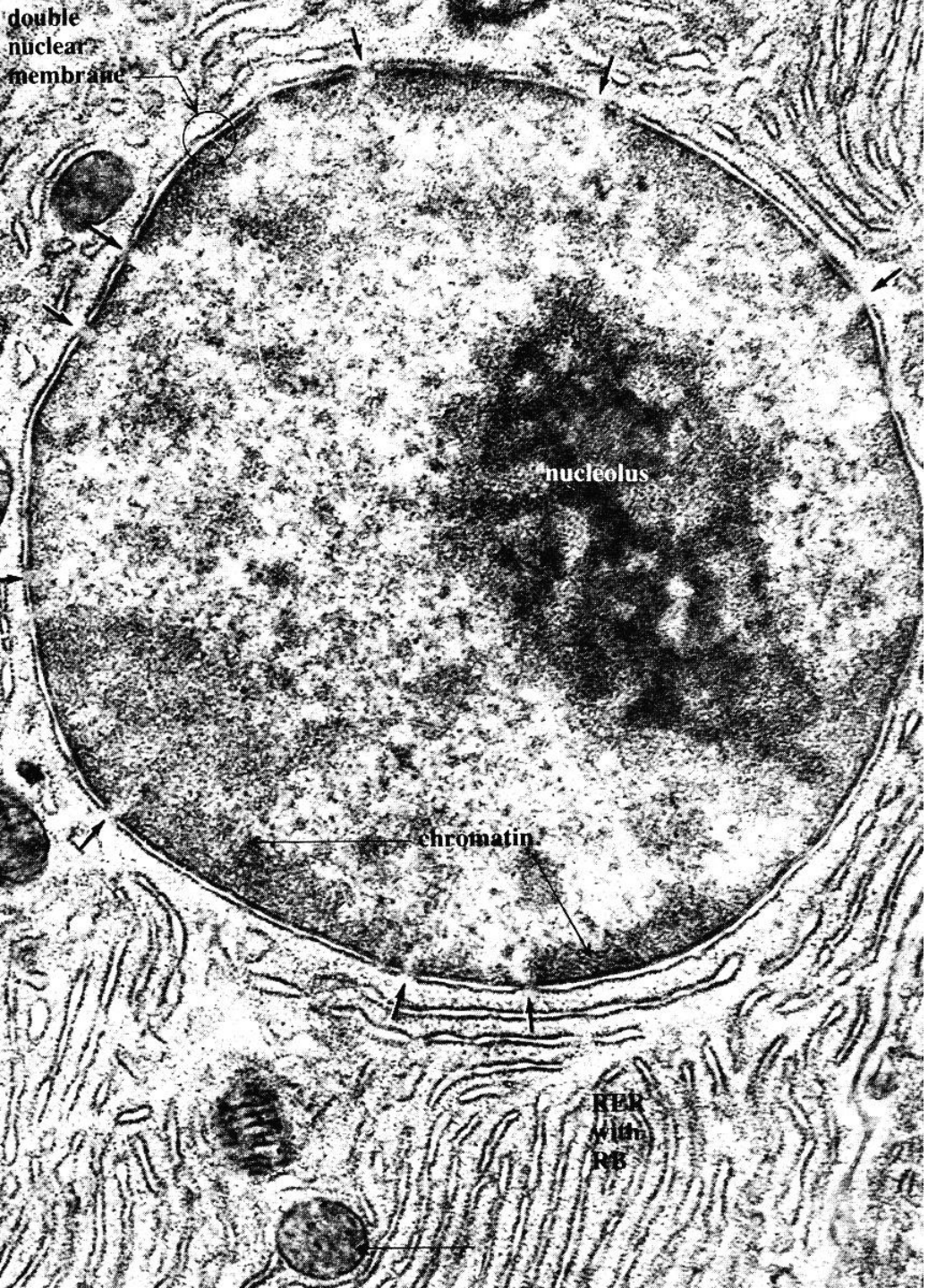
意識

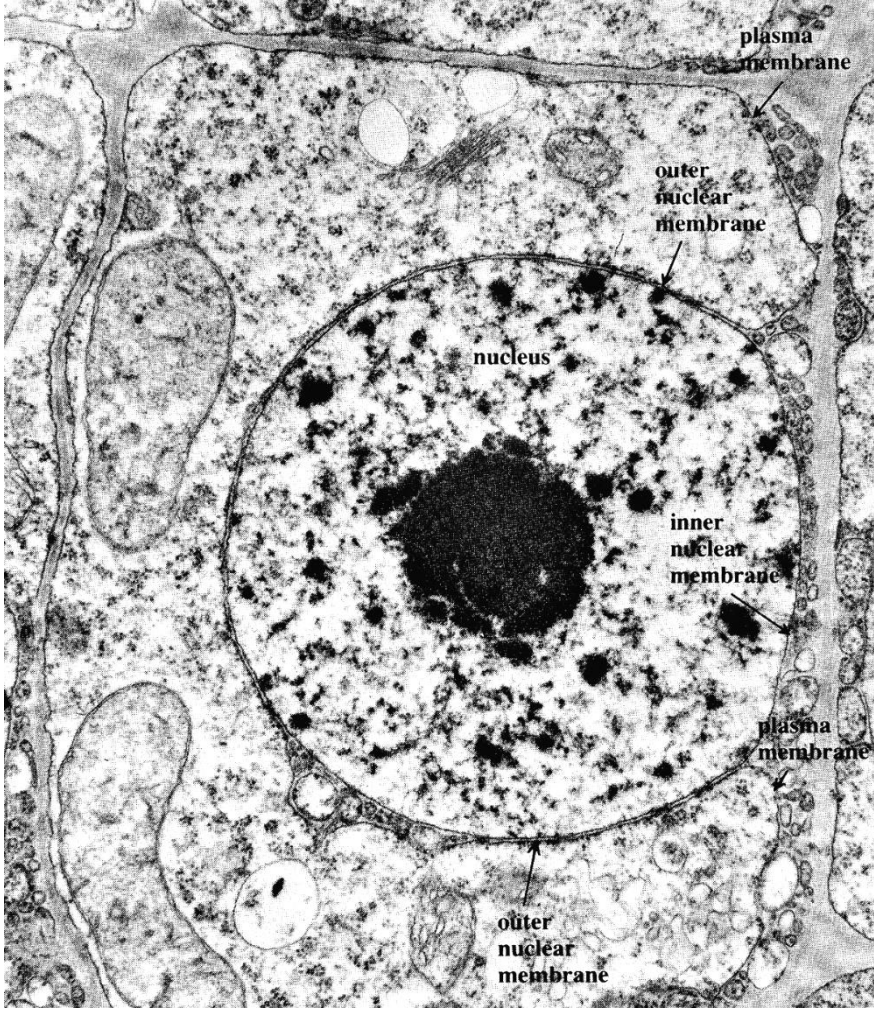


- **C61 不可思議內在世界**
  - C61a 大腦演化等
  - C61b 腦海漫遊
- **C62 心思控制的力量**
- **C63 每個人的終極問題**

參考圖片


細胞壁
細胞質
Ribosomes
Cytoplasm
Cell wall
Capsule
Mesosome
Bacterial Flagellum
染色體
DNA (nucleoid)
Plasma membrane

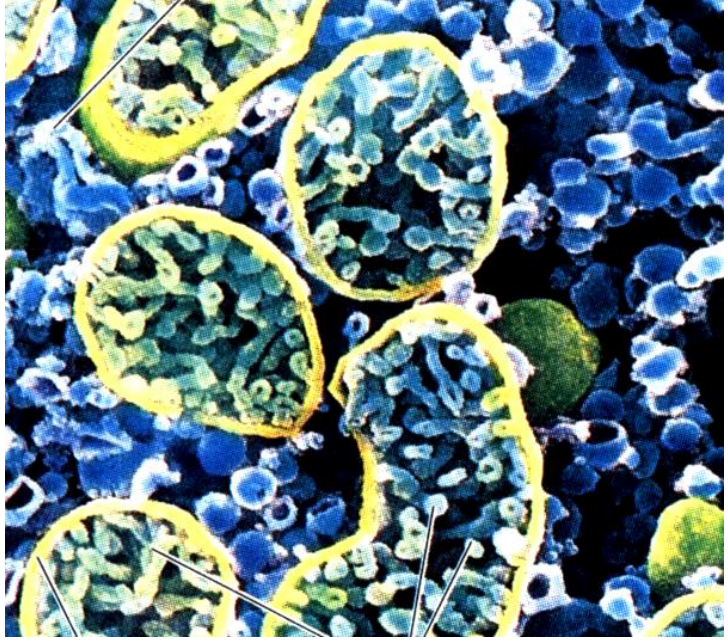

double
nuclear
membrane
nucleolus
chromatin
RER
with
RB

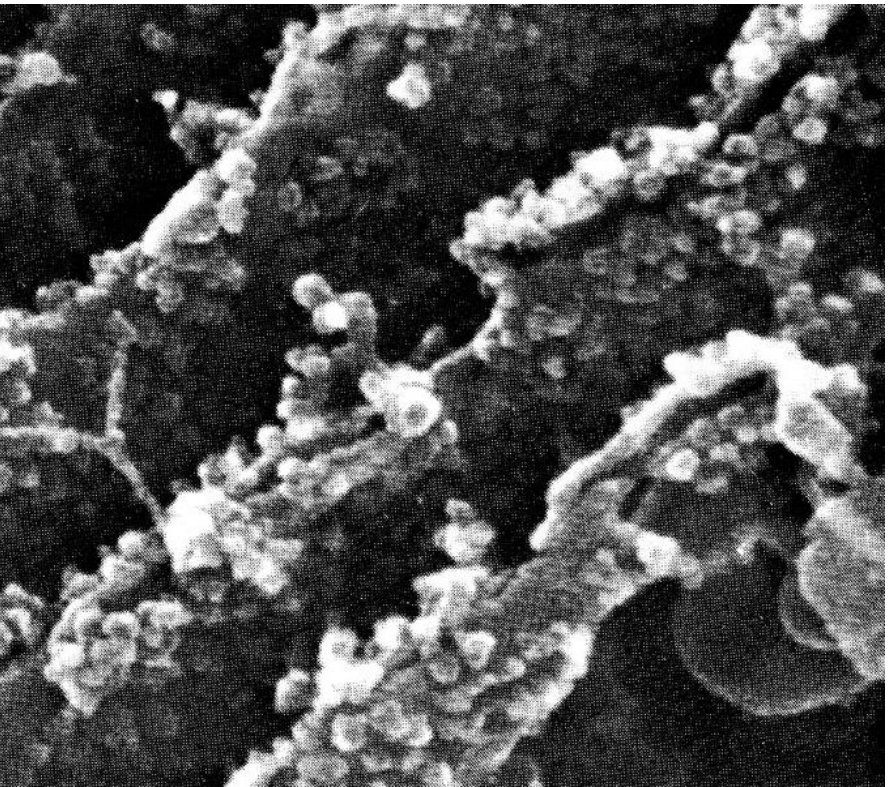

plasma
membrane
outer
nuclear
membrane
nucleus
inner
nuclear
membrane
plasma
membrane
outer
nuclear
membrane

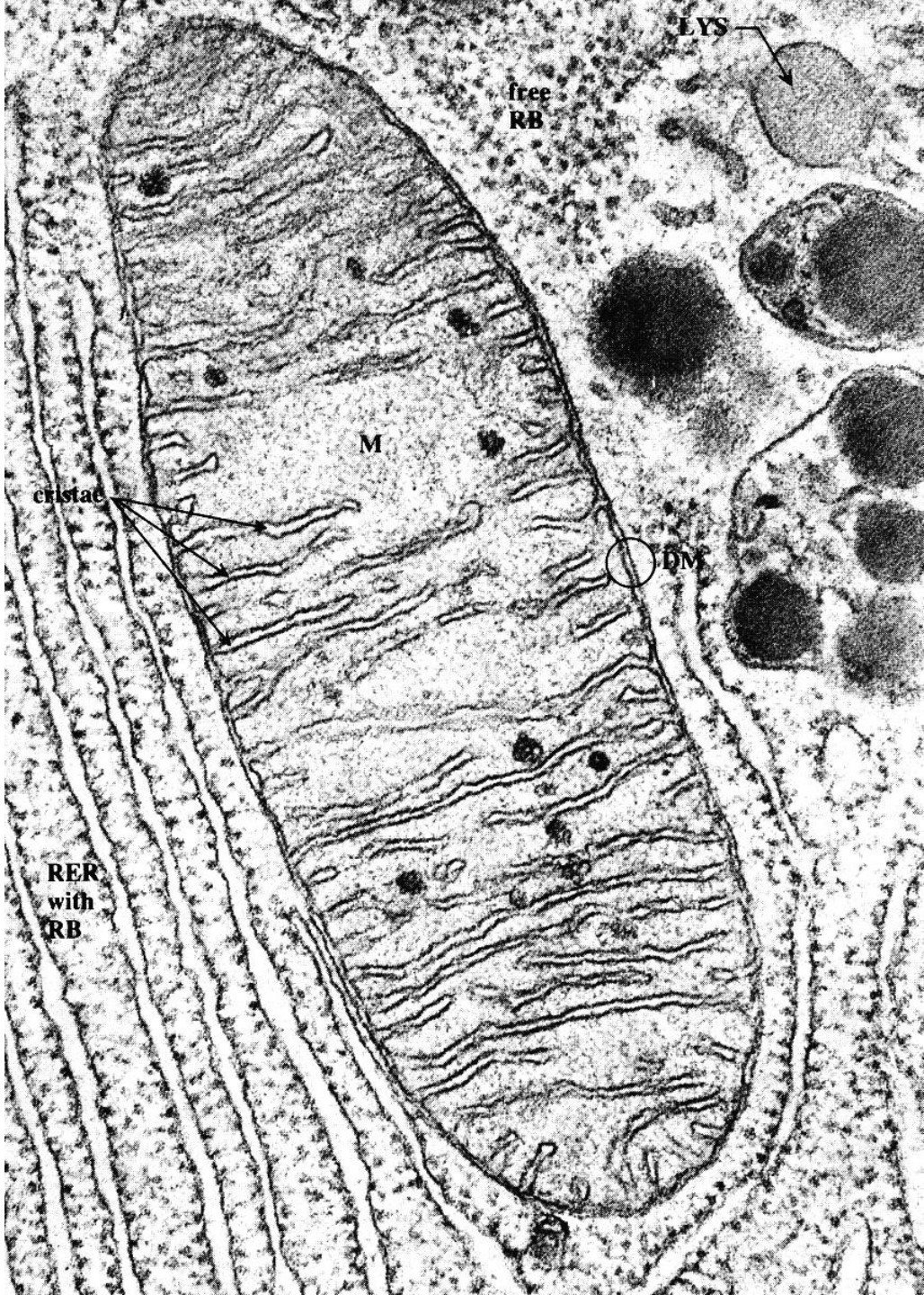
經典之作

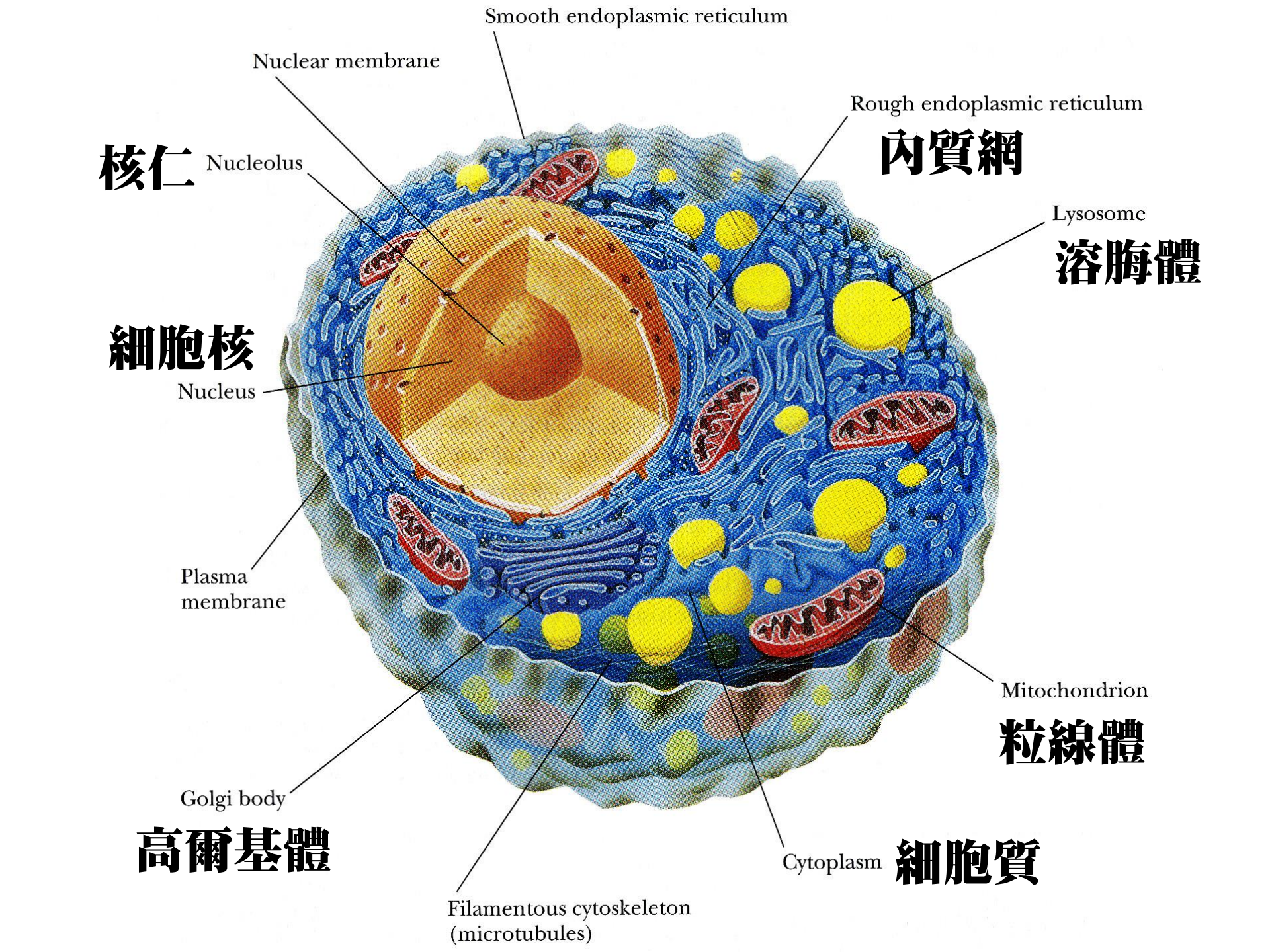
細胞核、核仁

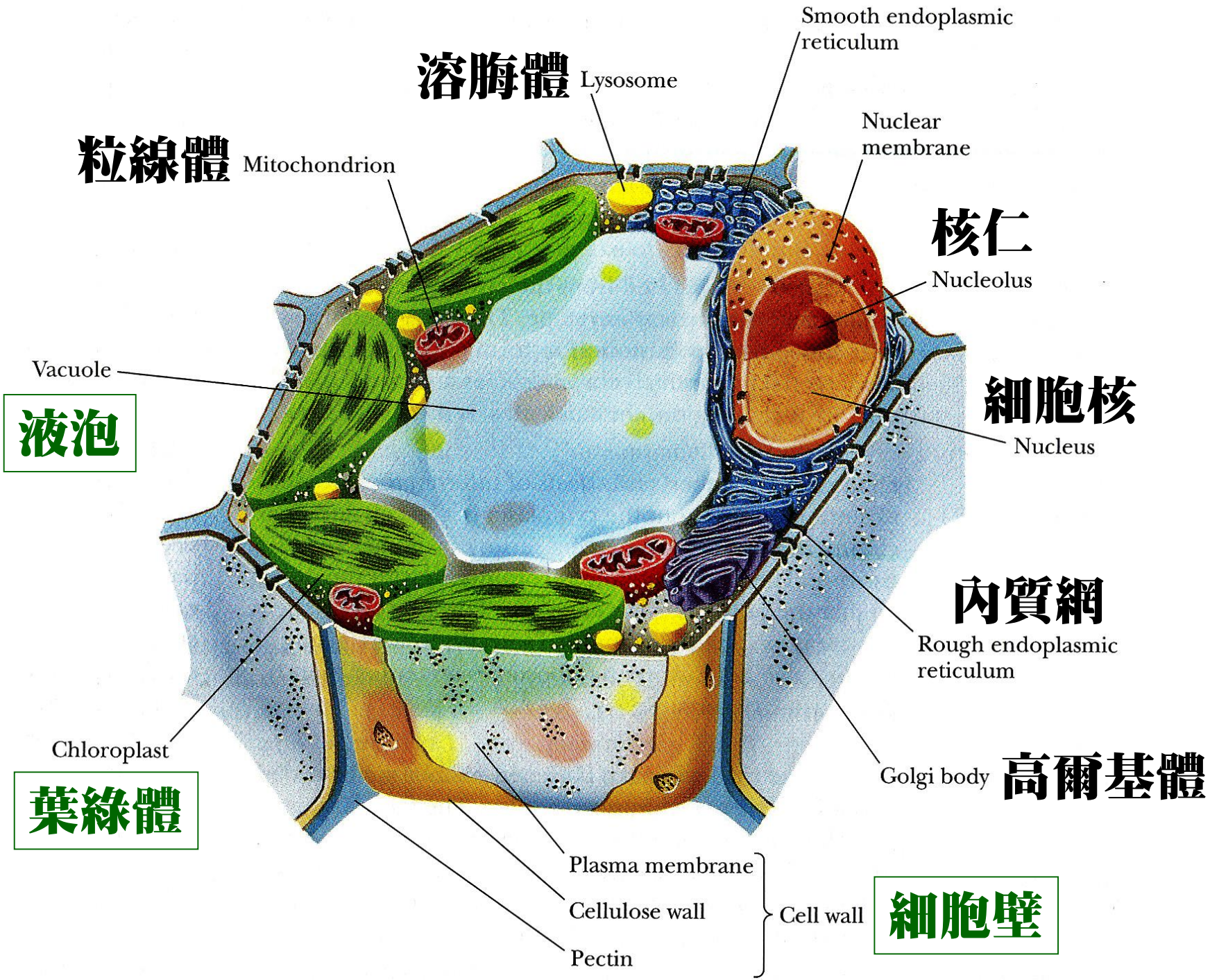
粒線體 內質網

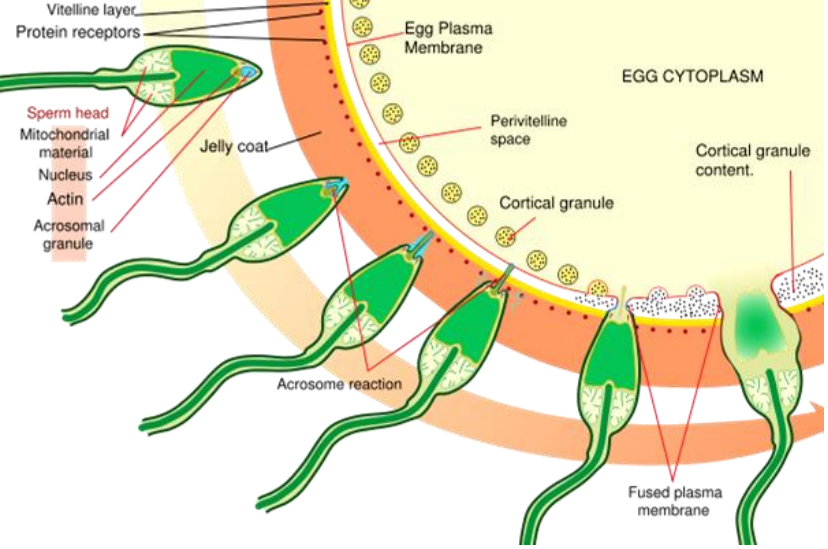


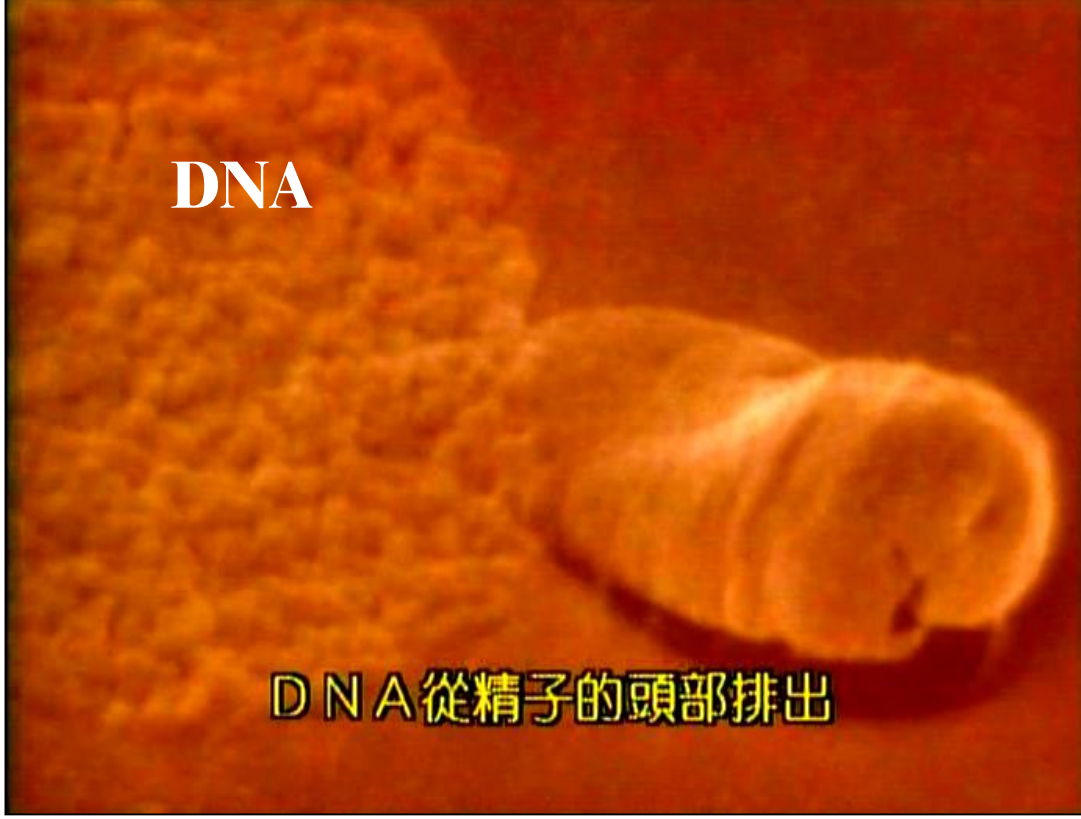





Smooth endoplasmic reticulum
Nuclear membrane
Rough endoplasmic reticulum
內質網
核仁
Nucleolus
Lysosome
溶胞體
細胞核
Nucleus
Plasma membrane
Mitochondrion
粒線體
Golgi body
高爾基體
Cytoplasm
細胞質
Filamentous cytoskeleton (microtubules)

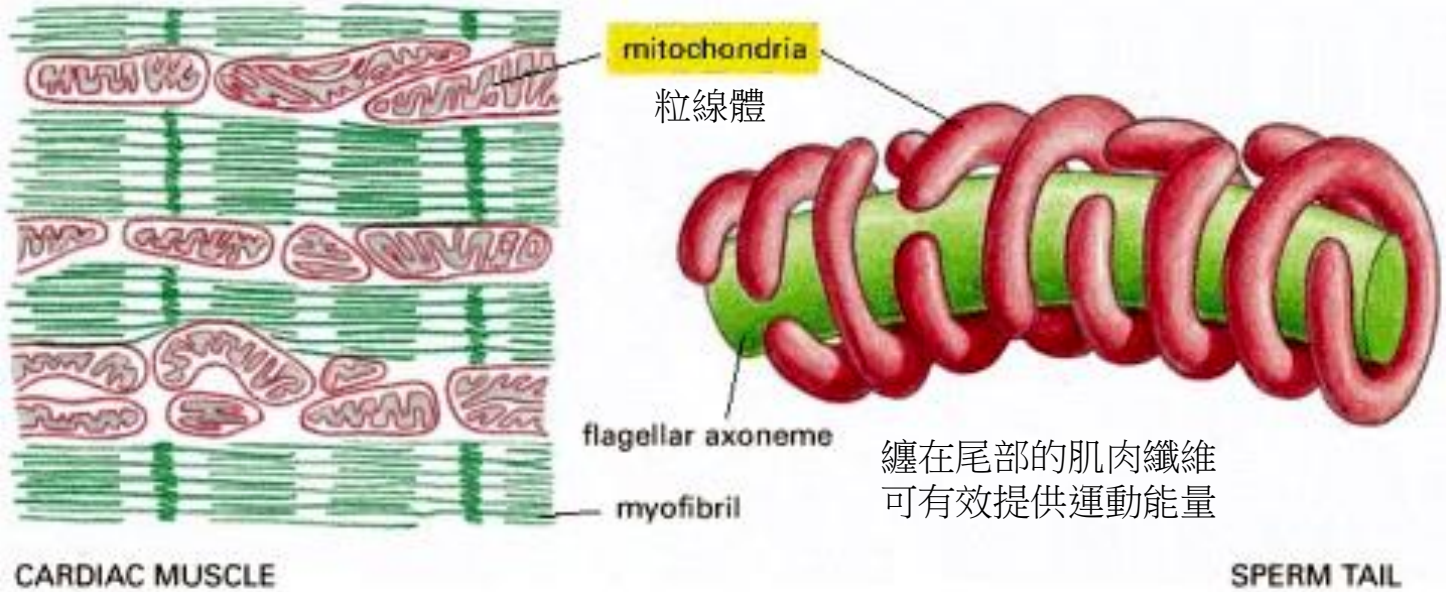

Smooth endoplasmic reticulum
溶胞體 Lysosome
Nuclear membrane
粒線體 Mitochondrion
核仁
Nucleolus
Vacuole
液泡
細胞核
Nucleus
內質網
Rough endoplasmic reticulum
Chloroplast
葉綠體
Golgi body
高爾基體
Plasma membrane
Cellulose wall
Pectin
Cell wall
細胞壁





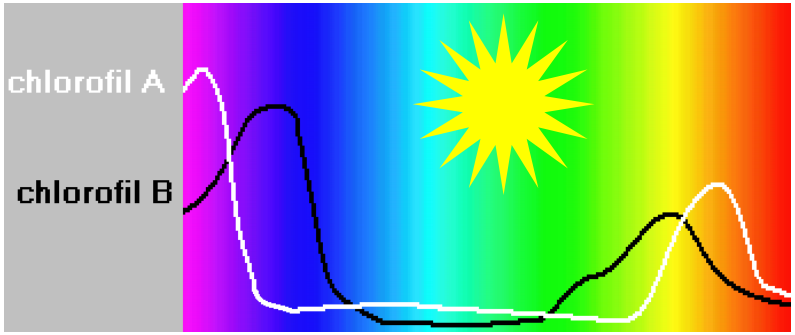
只有染色體 DNA 進入

粒線體呢？



Alberts et al (2002)
Molecular Biology of the Cell
(4e) Figure 14-6

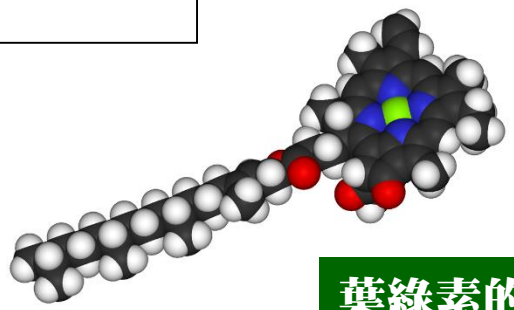
WIKIPEDIA

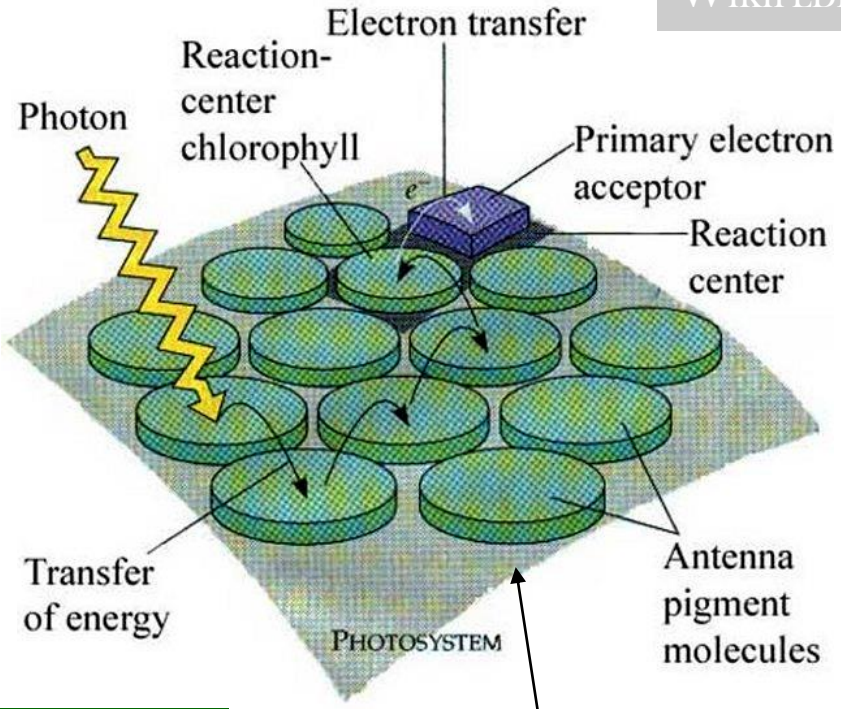


$$H_2O \xrightarrow{e^-} O_2 \ \& \ H^+$$

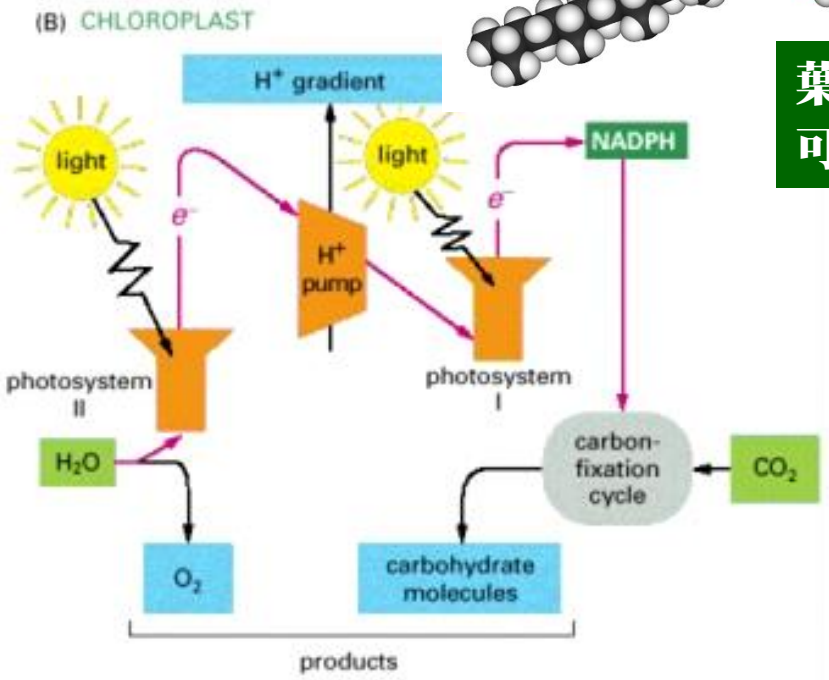
光能被吸收激發電子
最後分解水放出質子

葉綠素

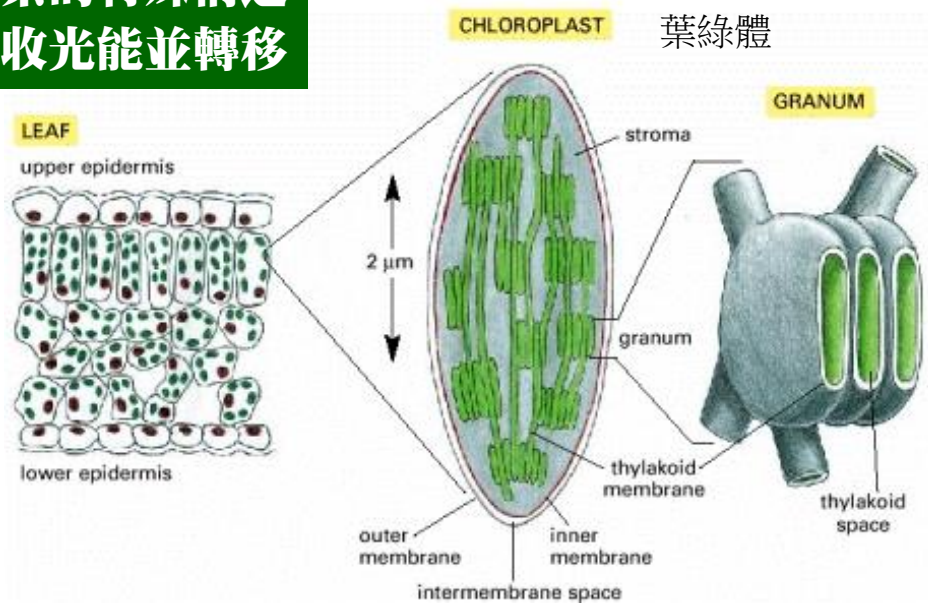




葉綠素的特殊構造
可吸收光能並轉移

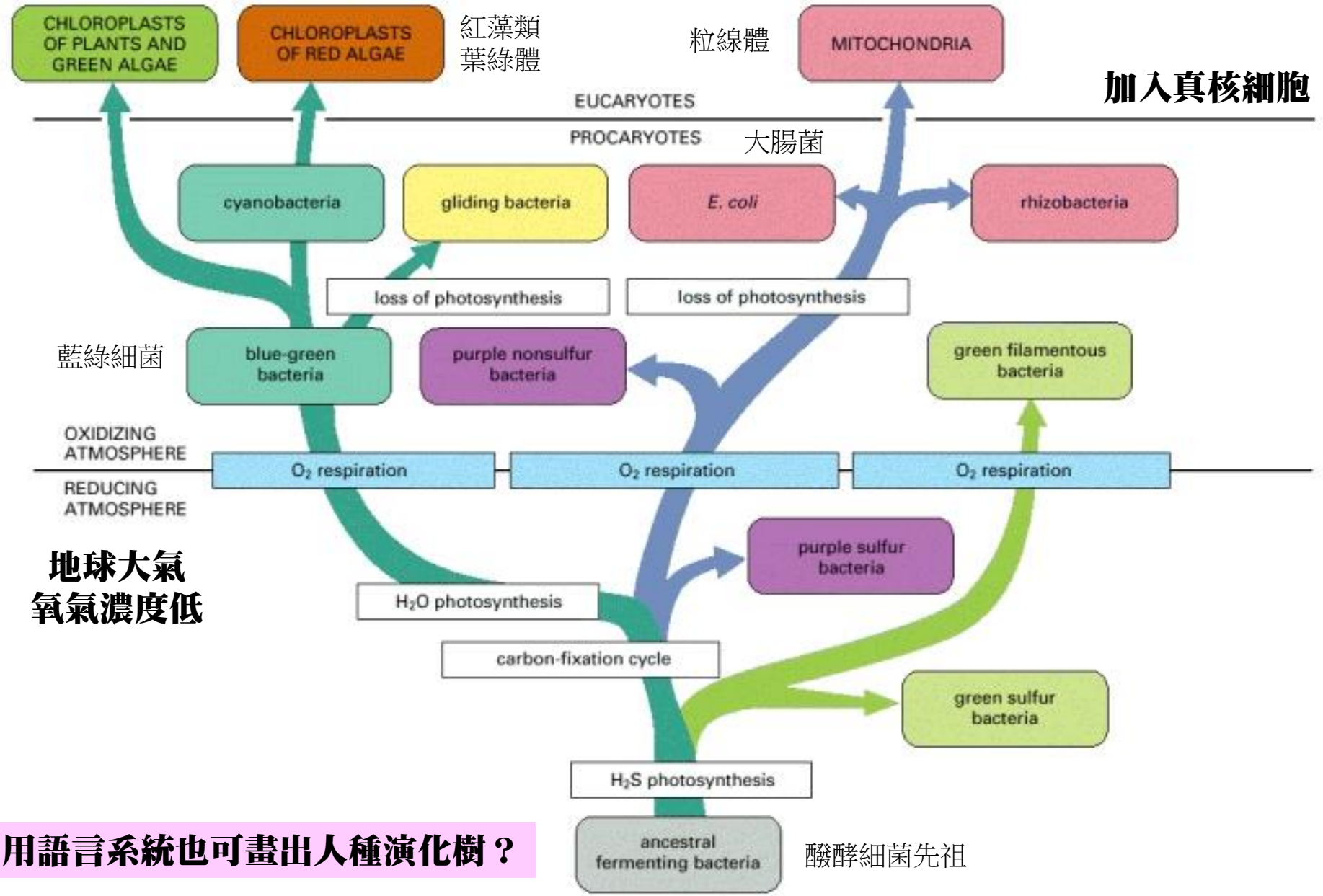


葉綠體



Alberts et al (2002) Molecular Biology of the Cell (4e) Figure 14-3B & 14-35

粒線體與葉綠體等胞器之演化族譜：



用語言系統也可畫出人種演化樹？

Alberts et al (2002) Molecular Biology of the Cell (4e) Figure 14-70