

# MATERI KULIAH MIKROBIOLOGI STRUKTUR FUNGSI SEL PROKARIOTIK 1

Anna Rakhmawati

Jurdik Biologi FMIPA UNY

Email: [anna\\_rakhmawati@uny.ac.id](mailto:anna_rakhmawati@uny.ac.id)

2014

# STRUKTUR dan FUNGSI SEL PROKARIOTIK

Struktur -----fungsi

Karakteristik sel prokariotik ----- bentuk & ukuran

Morfologi -----bentuk dasar sel bakteri

coccus, batang, spiral -----variasi

spirochete, budding, berfilamen

Morfologi sama



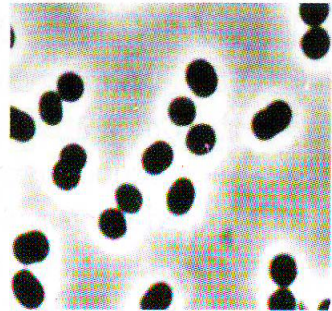
---

beda fisiologi, ekologi, filogeni, atau karakter lain

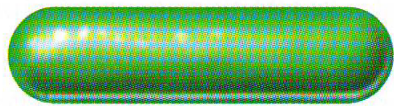
# Bentuk sel bakteri



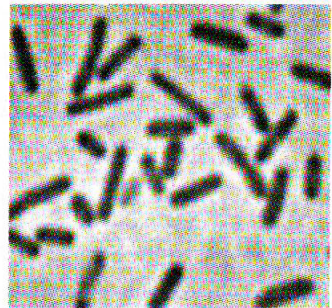
Coccus



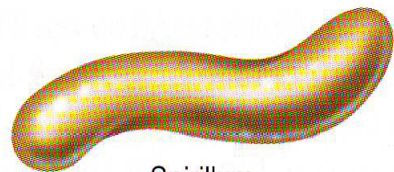
Norbert Pfennig



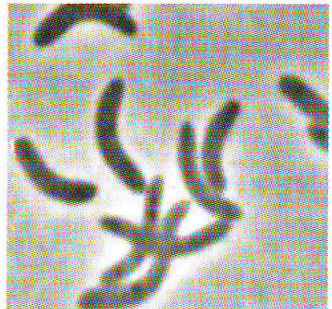
Rod



Norbert Pfennig



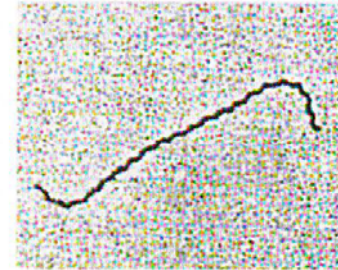
Spirillum



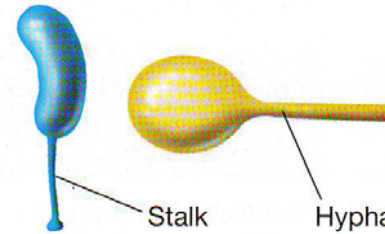
Norbert Pfennig



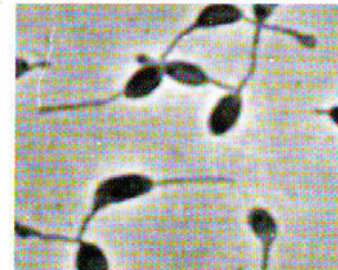
Spirochete



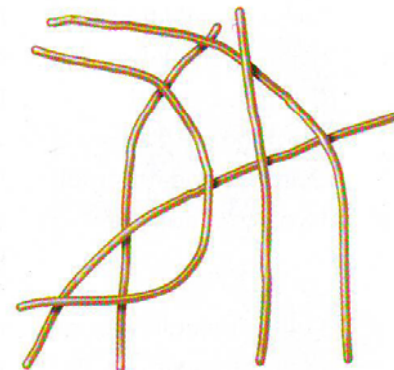
E. Canale-Parola



Budding and appendaged bacteria



Norbert Pfennig

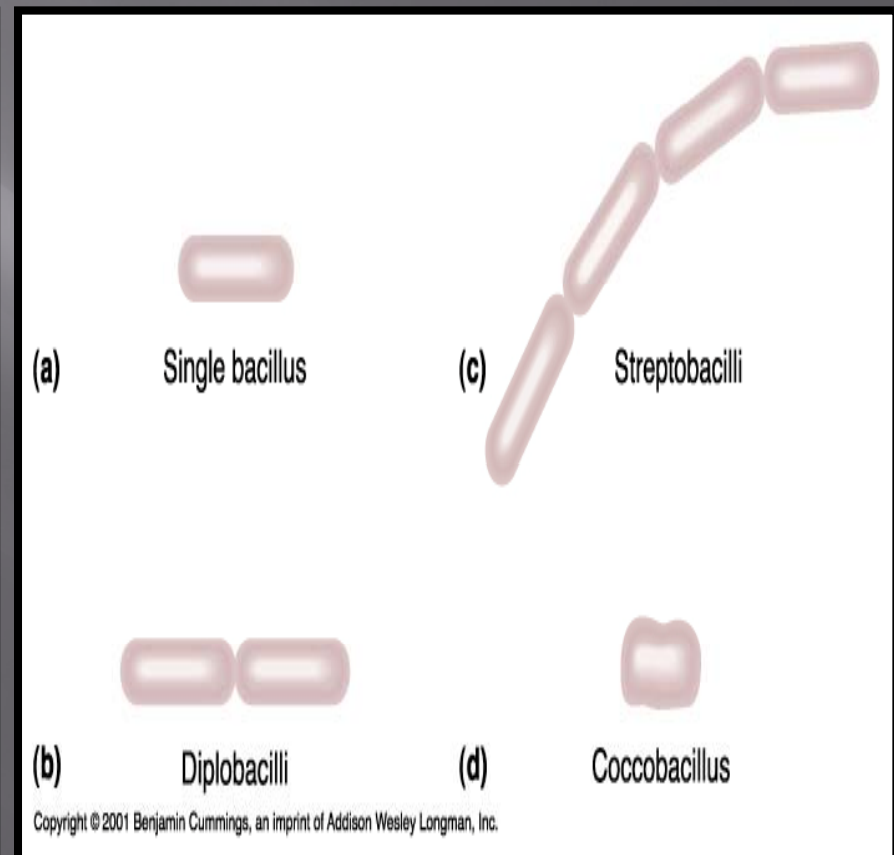
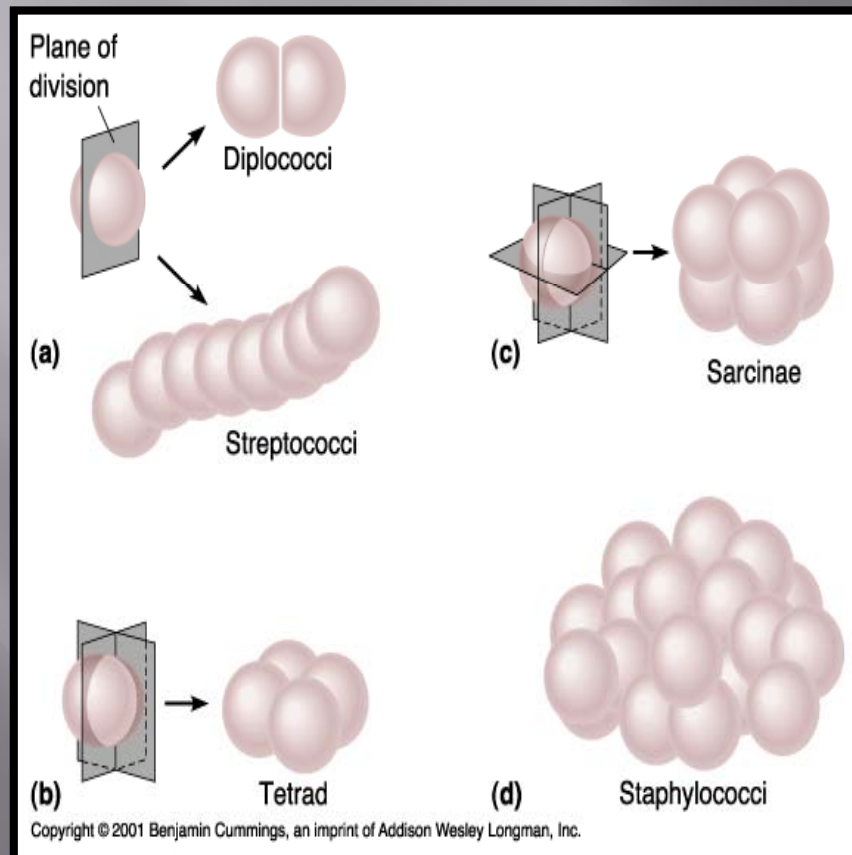


Filamentous bacteria



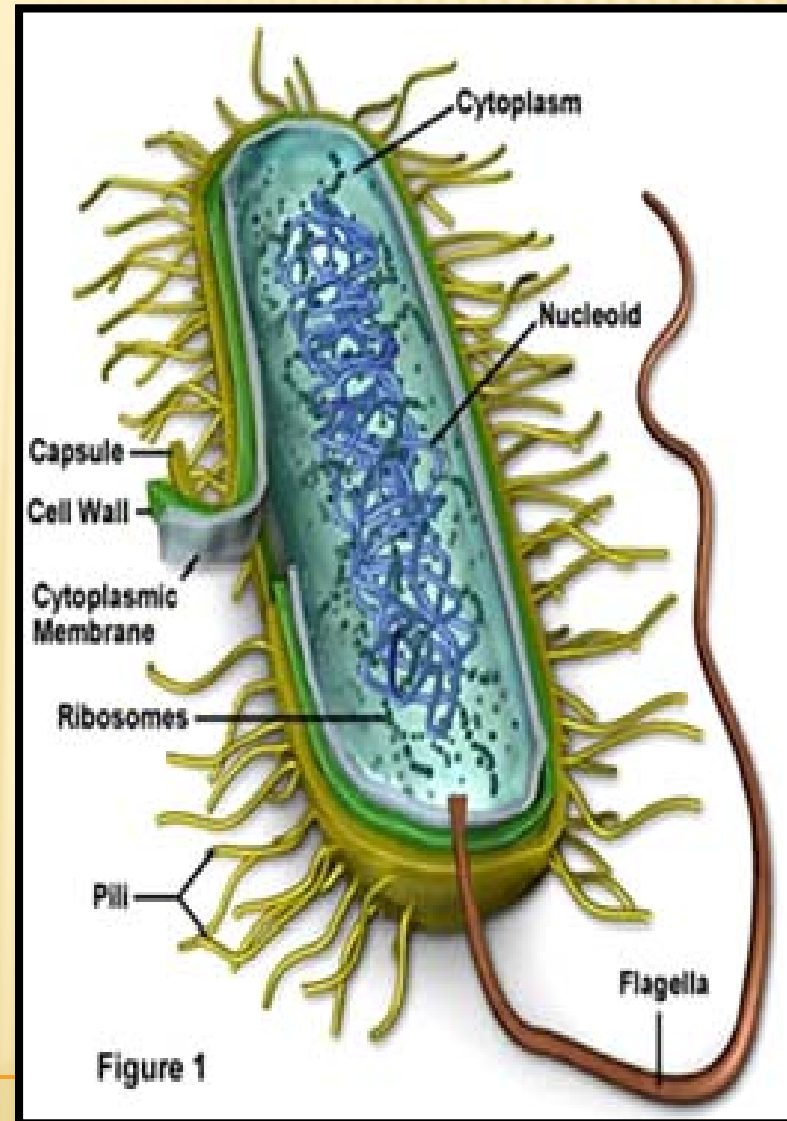
T. D. Brock

# Bentuk dasar sel bakteri



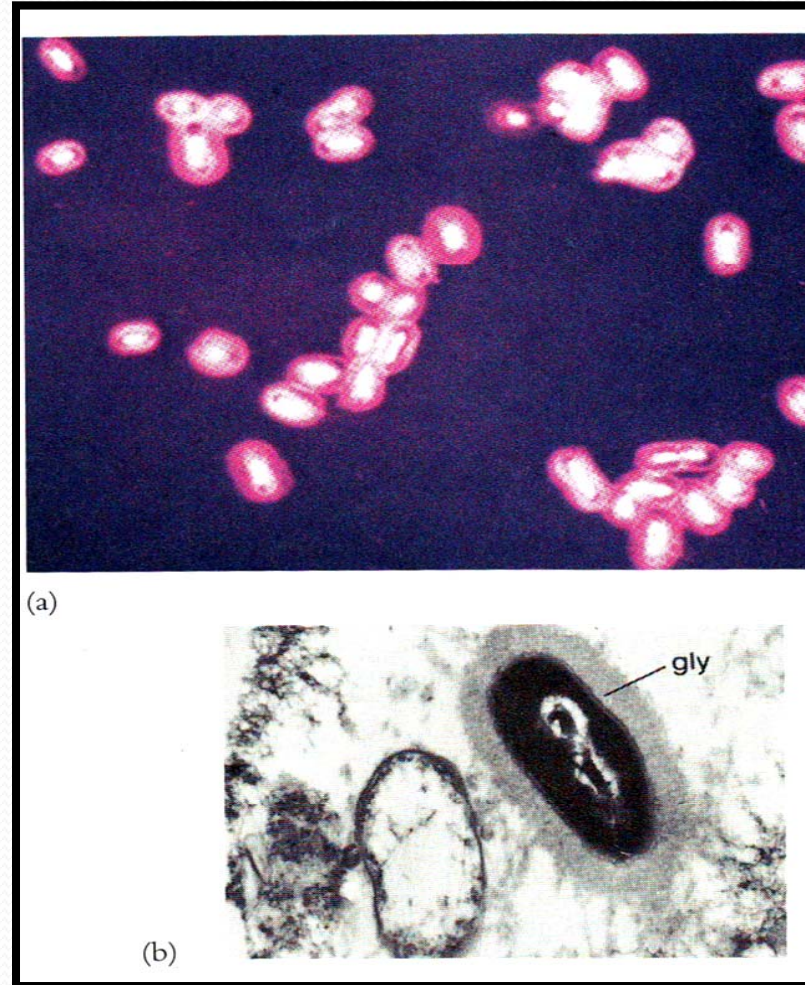
## STRUKTUR UMUM SEL BAKTERI

- Sel prokariotik
- diameter 0,2-2,0 $\mu$ m; panjang 2,0-8,0 $\mu$ m
- *Epulopiscium fishelsoni* (0,6 mm)
- *Thiomargarita namibiensis* (0,75 mm)
- Struktur eksternal ddg sel:
  - Glycocalyx, flagella, axial filamen, fimbriae, dan pili
- Struktur internal ddg sel:
  - membran sitoplasma, sitoplasma, nucleoid, dan ribosom



## Glikokaliks

- Mantel gula
- substansi di sekitar sel
- material sepanjang luar sel
- polisakarida, polipeptida
- Erat terkait ddg sel -----  
Kapsul
- Krg terkait ddg sel ---  
lapisan lendir
- Melindungi fagositosis
- Perikatan
- Sumber nutrisi
- Mencegah dehidrasi



# Flagella

- Bbrp sel bakteri
  - Pergerakan (motilitas)
    1. Filamen ---protein flagellin
    2. Hook (pengait)
    3. Basal body---melabuhkan flagella
- Gram + 1 pasang cincin  
Gram – 2 pasang cincin  
Archae lbh tipis-flagellin (glikoprotein)

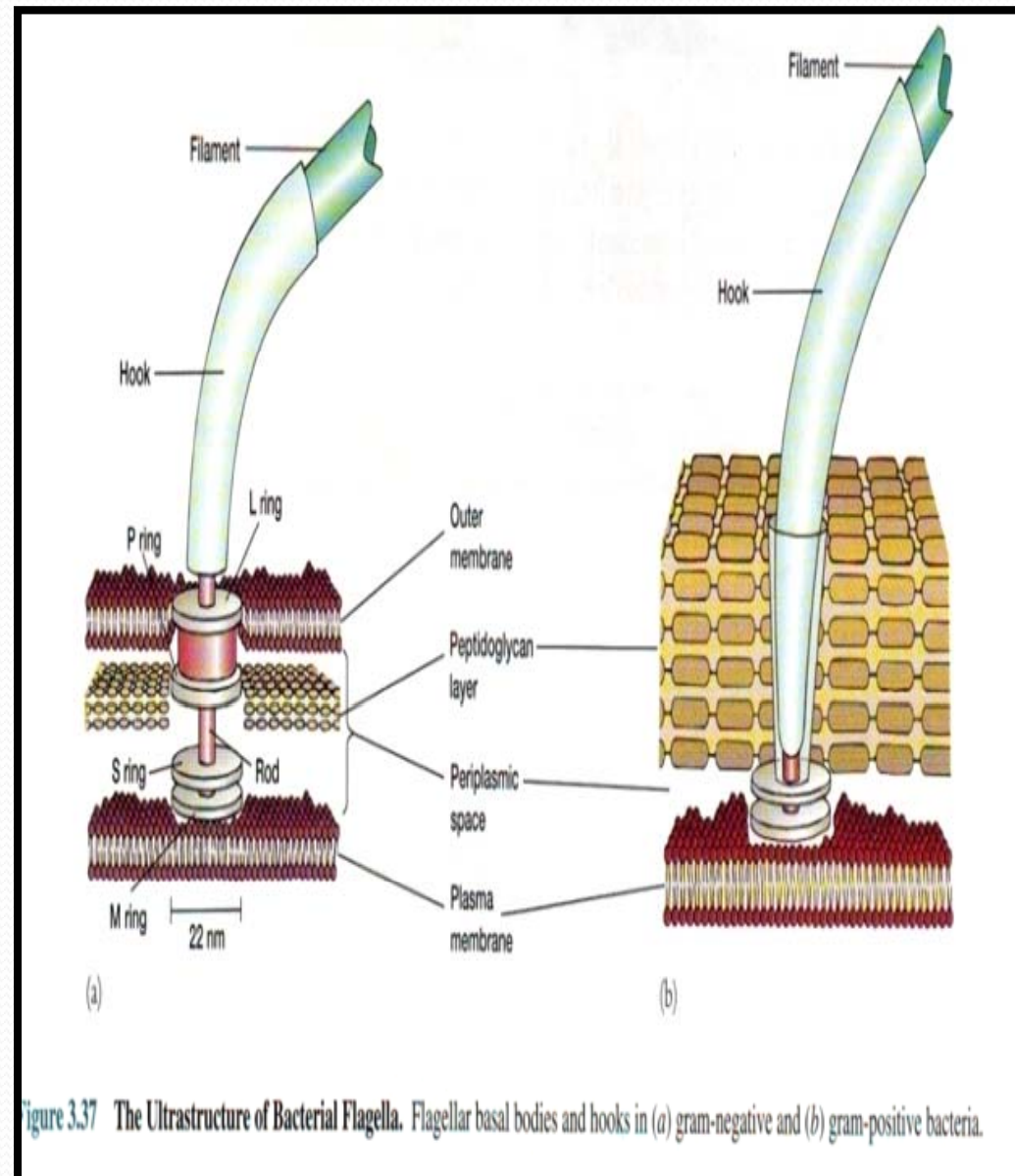


Figure 3.37 The Ultrastructure of Bacterial Flagella. Flagellar basal bodies and hooks in (a) gram-negative and (b) gram-positive bacteria.

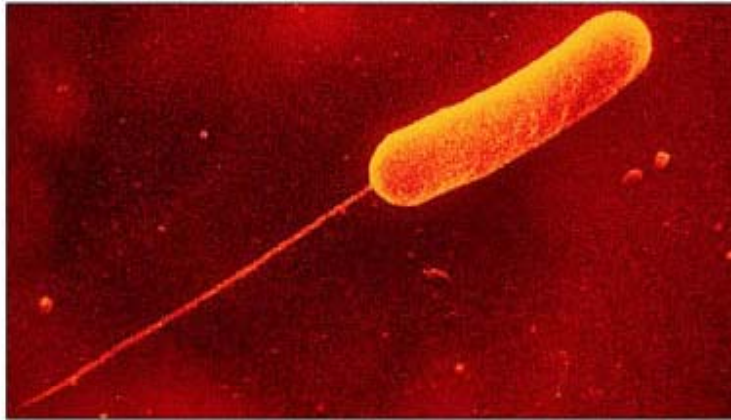
# Pengaturan flagella

a. Tunggal

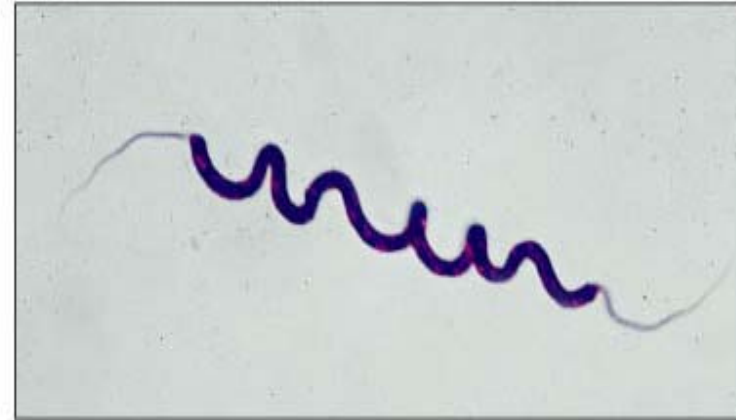
b. Stp akhir sel

c. 2/lbh di kutub sel

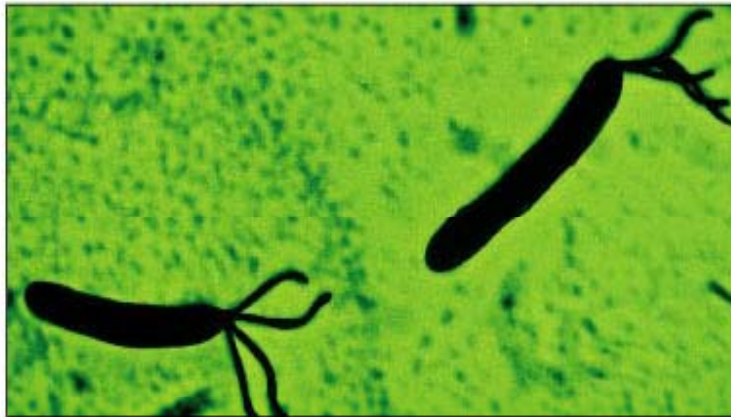
d. Seluruh sel



(a) Monotrichous



(b) Amphitrichous



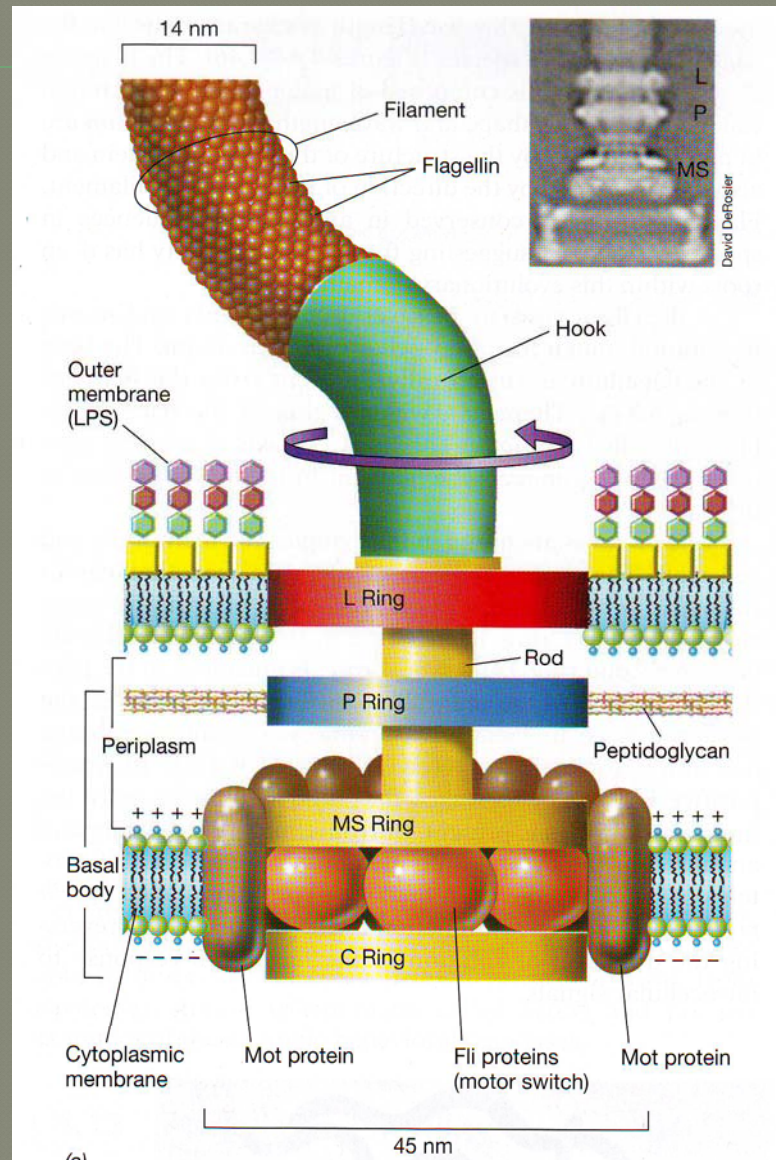
(c) Lophotrichous



(d) Peritrichous



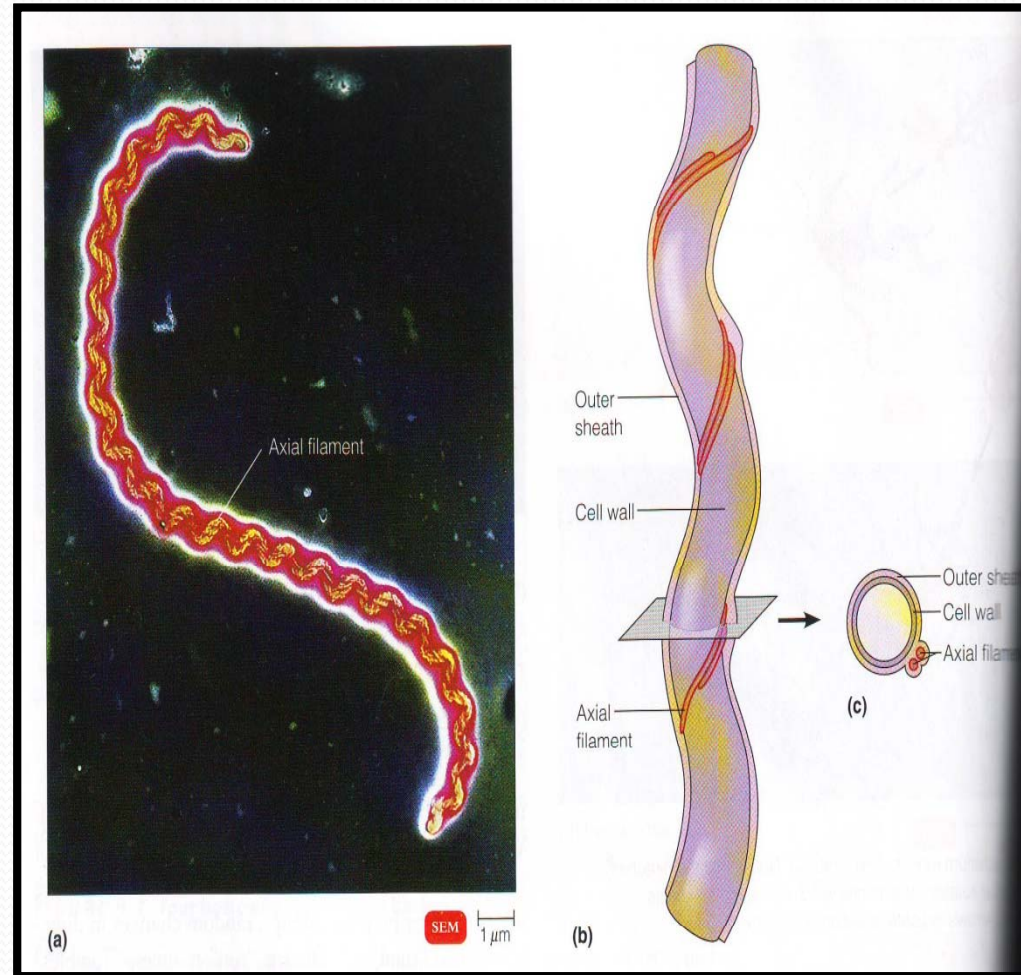
# Ultrastruktur flagella



## Endoflagella/ axial filament

- Struktur mirip flagella
- Terkait salah satu sisi
- Sarung
- Spiral mengelilingi sel

Ex: *Treponema pallidum*  
*Leptospira sp*

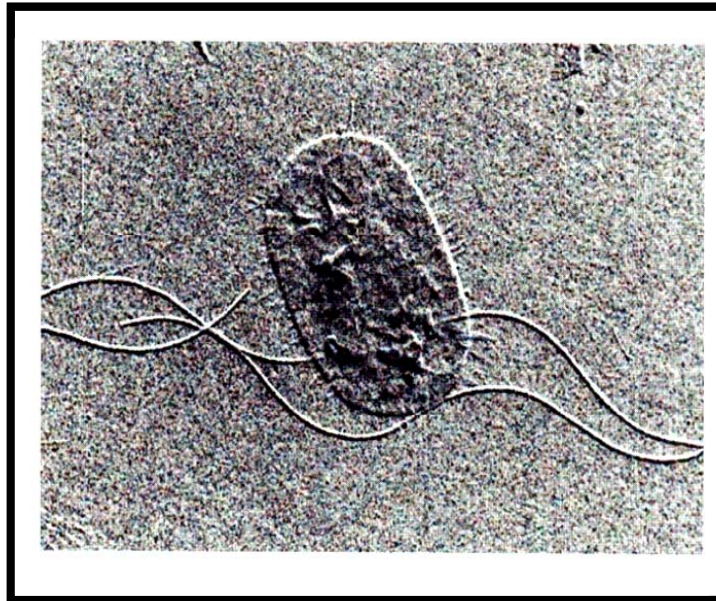


# FIMBRIAE DAN PILI

## PENDEK, LURUS, TIPIS; PROTEIN PILIN

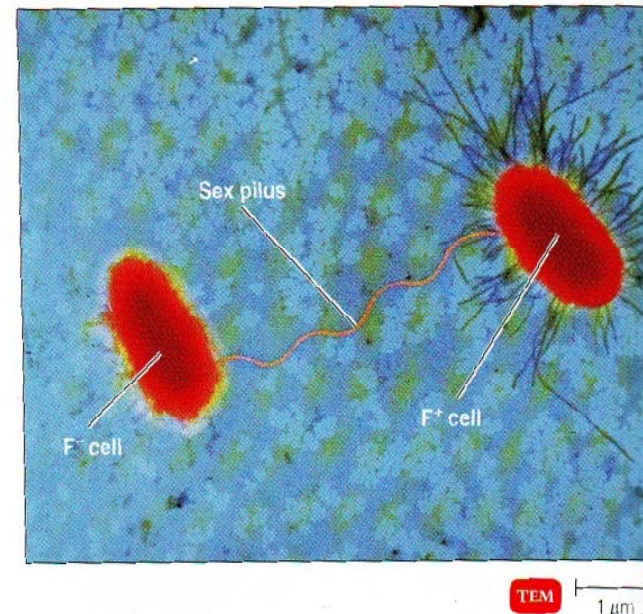
### Fimbriae

- kutub/distribusi
- jml bbrp-ratusan
- perlekatan;



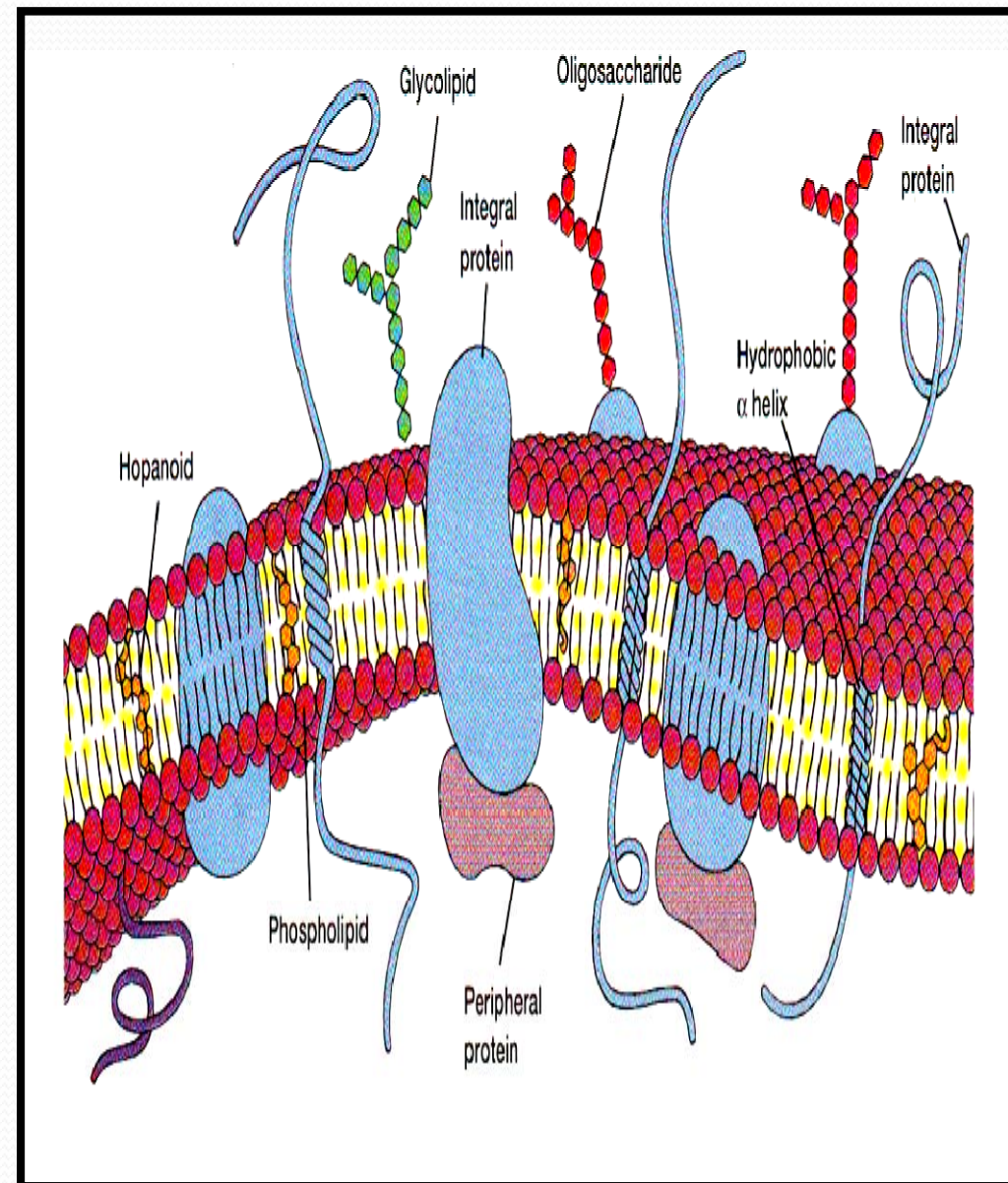
### Pili

- lebih panjang; -jml 1 / 2 per sel
- reseptor bbrp virus
- twitching motility* (kejang)
- sex pili

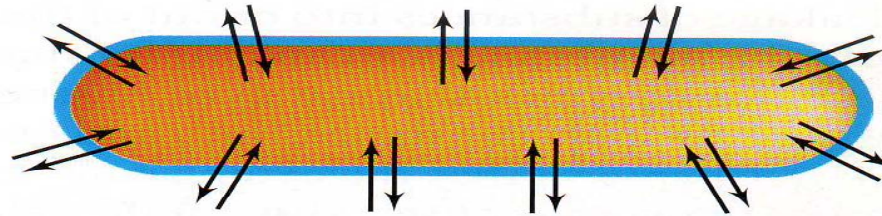


## Membran plasma/ membran sitoplasma

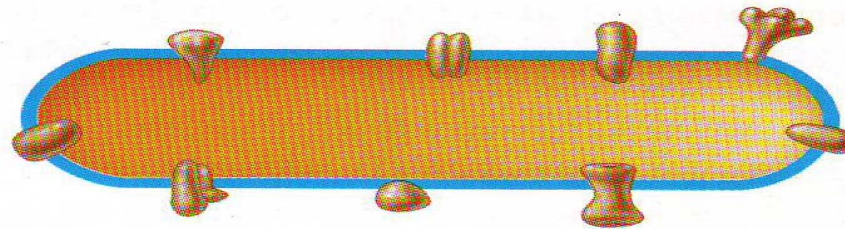
- Selektif barrier
- Pemecahan nutrien, E
- fosfolipid bilayer
- ikatan ester atr asam lemak & gliserol
- Tdk mpy sterol (krng kaku;kuat;stabil)
- Hopanoid
- Mycoplasma, bakteri metatotrofik -sterol



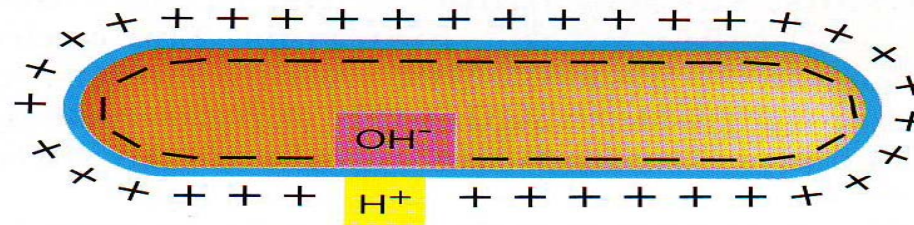
# Fungsi utama membran sel



- 1. Permeability Barrier** — Prevents leakage and functions as a gateway for transport of nutrients into and out of the cell



- 2. Protein Anchor** — Site of many proteins involved in transport, bioenergetics, and chemotaxis



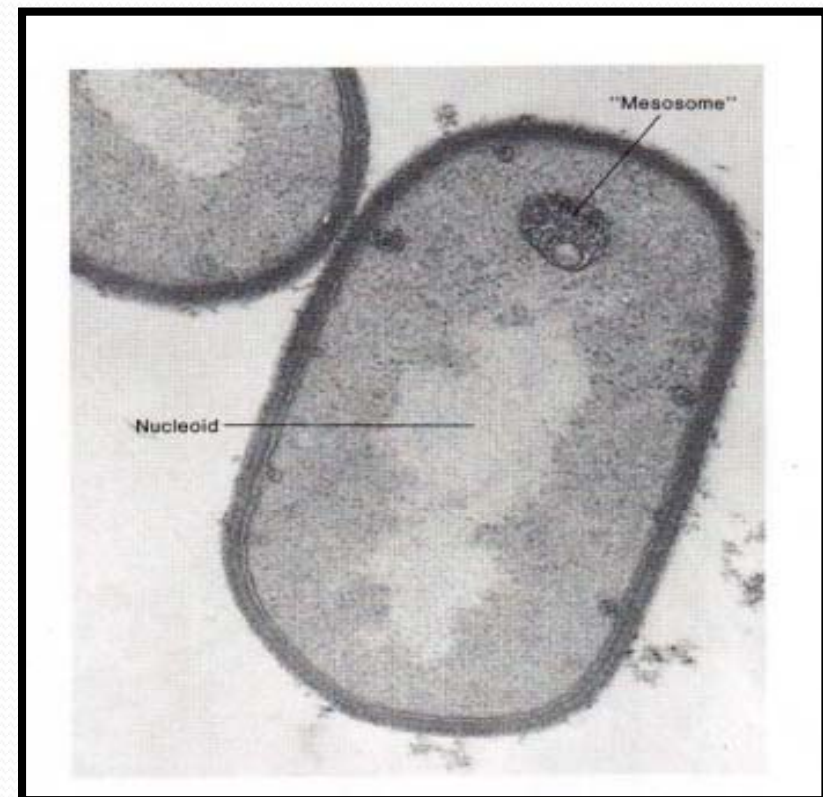
- 3. Energy Conservation** — Site of generation and use of the proton motive force

## Struktur dalam – membran plasma

Kromatofor-fotosintesis

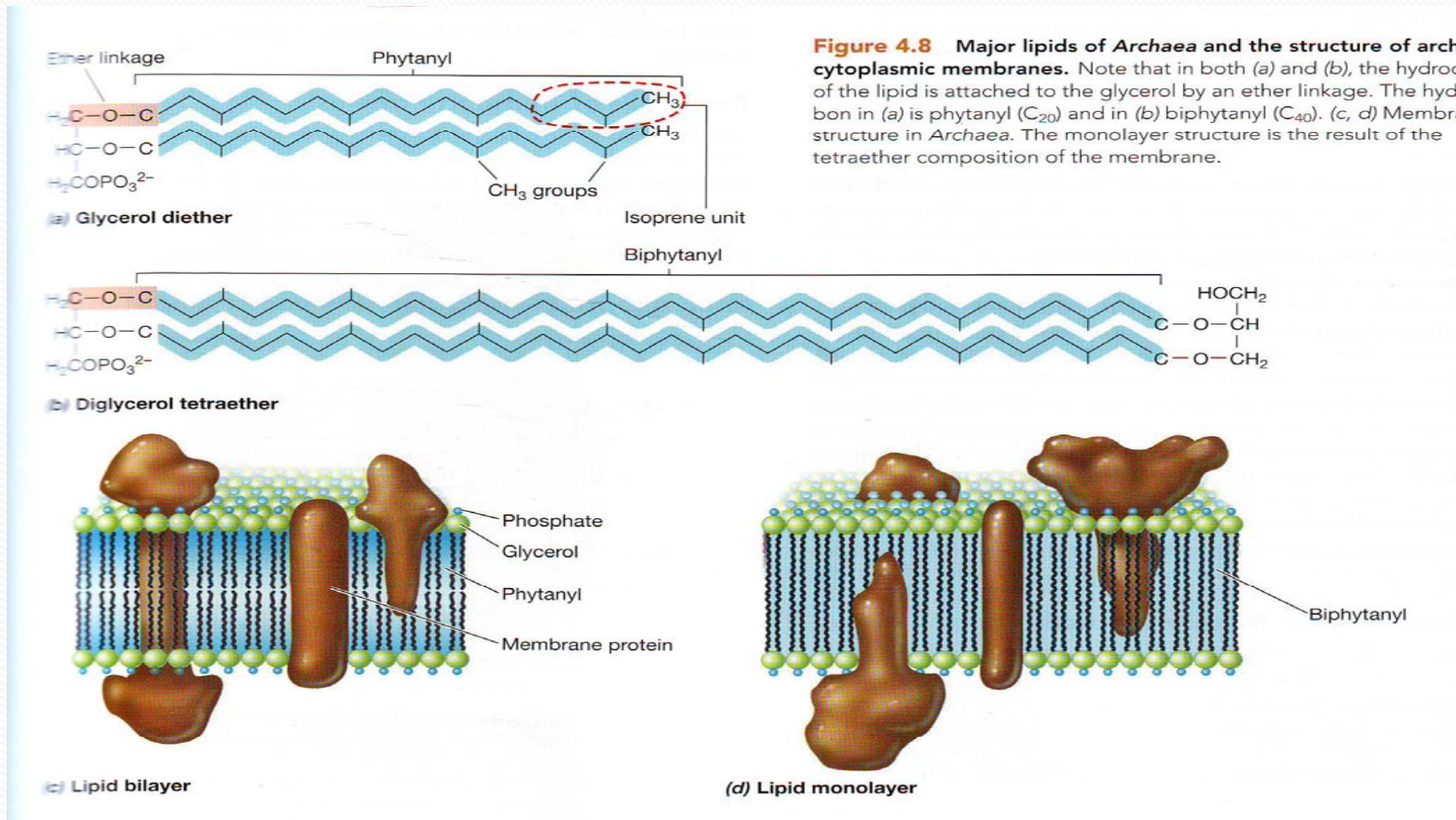


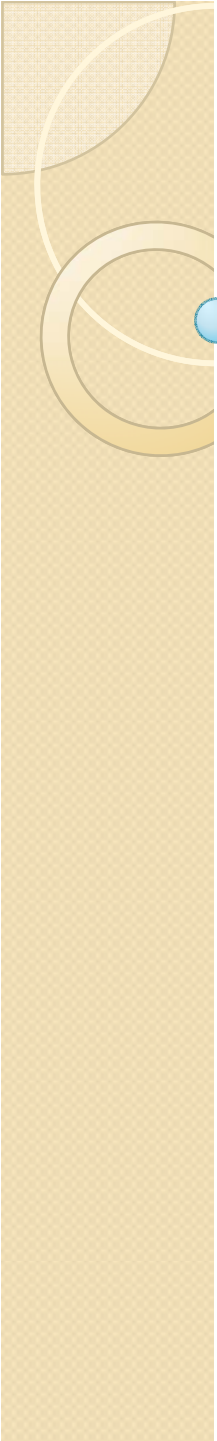
Mesosom-pembtikan ddg sel,  
replikasi kromosom,sekretori,  
artifak



# Membran plasma archaee

tdk mpy hopanoid; tdk py asam lemak; ikatan eter atr gliserol dg sisi hidrofob (isoprene)





# Nucleoid/area nuclear/nuclear body/chromatin body

- sirkuler untaian DNA
- Tdk diliputi membran inti; tidak mempunyai histon
- Elemen genetik ekstrakromosom = plasmid

## RIBOSOM

- Sintesis protein
- Kenampakannya spt granuler
- Ukuran 70S

## SITOPLASMA

- substansi dlm membran plasma
- 80% air mengandung prot (enzim),kh,lipid,ion inorganik, senyw BM rendah





## Inclusion

- deposit penyimpanan
- akumulasi ktk nutrien byk, digunakan ktk lingk. krg
- diliputi membran atipikal
- mengurangi tekanan osmosis
- I. Granula metakromatik
  - inclusion besar kdg tercat merah dg pengecatan biru (methylen blue)
  - secara kolektif=volutin
  - penyimpanan polifosfat
  - umumnya dibentuk dlm lingk kaya fosfat

## 2. Granula polisakarida

- memuat glikogen dan starch
- penambahan iod glik-coklat kemerahan; starch-biru

## 3. lipid inclusion

- poly- $\beta$ -hidroxybutyric acid (PHB)
- disintesis ketika lingk berlebihan-digunakan ketika kekurangan

## 4. sulfur granula

ex: Thiobacillus mengoksidasi sulfur/seny mengandung sulfur

## 5. carboxysom

mengandung enzim ribulose 1,5-difosfat carboxylase; fiksasi CO<sub>2</sub>

## 6. vakuola gas

-prokariotik akuatik;mengandung vesikel gas;mempertahankan daya apung

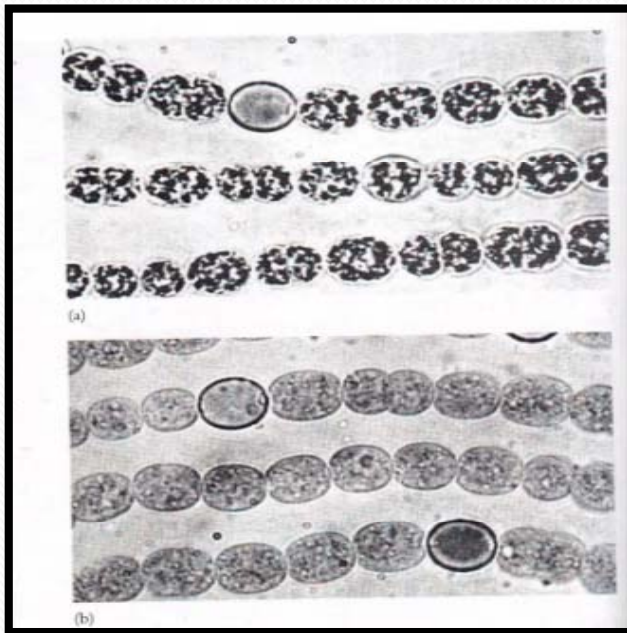
## 7. magnetosom

-mineral besi (Fe<sub>3</sub>O<sub>4</sub>), spt magnet,

ex: *Aquaspirillum magnetotacticum*

# Inclusion

Vakuola gas



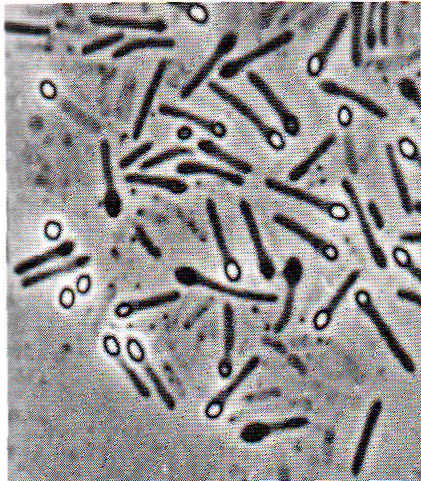
magnetosom



## Endospora

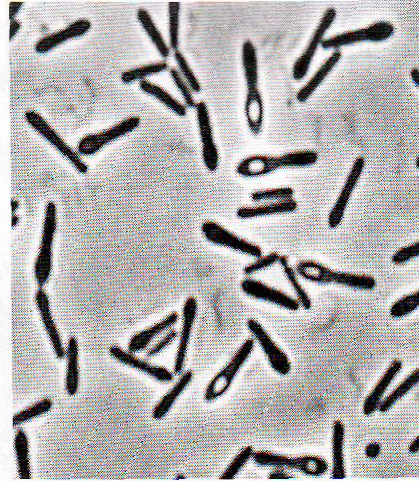
- "Resting" sel, fase dorman dlm siklus sel---  
sel vegetatif-endospora-sel vegetatif
- struktur ideal utk dispersal
- resisten thp panas, senyawa kimia toksik, radiasi
- Dibentuk saat nutrisi esensial menipis (C atau N)
- Proses pembentukan endospora dlm sel vegetatif=sporulasi memerlukan waktu bbrp jam  
(ex *B. subtilis*, 8 jam)
- Bakteri Gram positif, archaee blm ditemukan
- Substansi spesifik: dipicolinic acid (ditemukan dlm core) bergabung dg ion Ca diduga berfs mengurangi ketersediaan air (dehidrasi) dlm endospora dan menstabilkan DNA

# Letak endospora dan siklus hidup bakteri pembentuk endospora



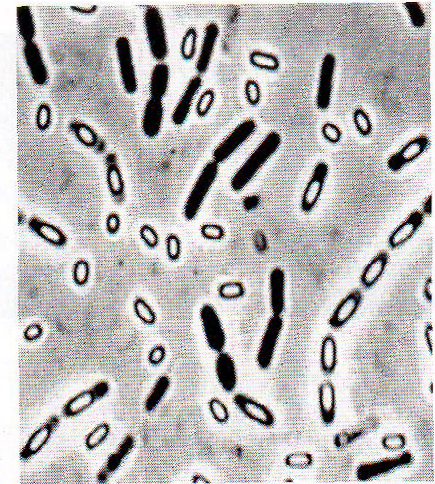
(a) Terminal spores

H. Hippe



(b) Subterminal spores

H. Hippe



(c) Central spores

H. Hippe

