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**LA EDAD DE LOS PROCARIONTES**

La característica más destacada de *la vida* ha sido la **estabilidad** de su modo de vida procariote, desde el comienzo del registro fósil hasta hoy. Vivimos en "La Edad de los Procariontes", así ha sido desde el inicio y continuará así hasta el fin de los tiempos. (The evolution of life on earth, Scientific American, October 1994).

**Stephen Jay Gould (1941-2002)**

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**LA EDAD DE LOS PROCARIONTES**

4500 M

3800 M

1500 M Eucarya

500 M Animalia

ca. 2500 M

5 M

Procariontes: 85% edad tierra  
Eucariontes: 33% e.t.  
Metazoos: 10% e.t.

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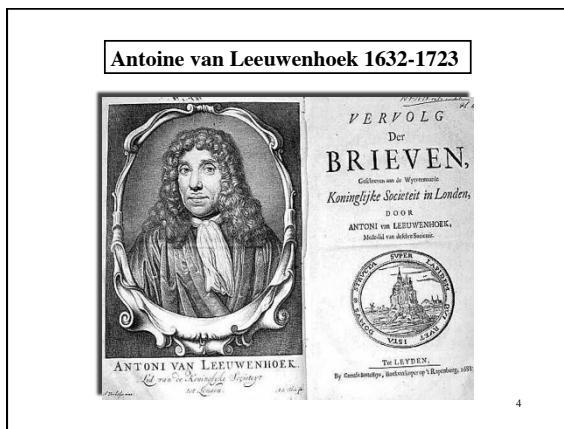
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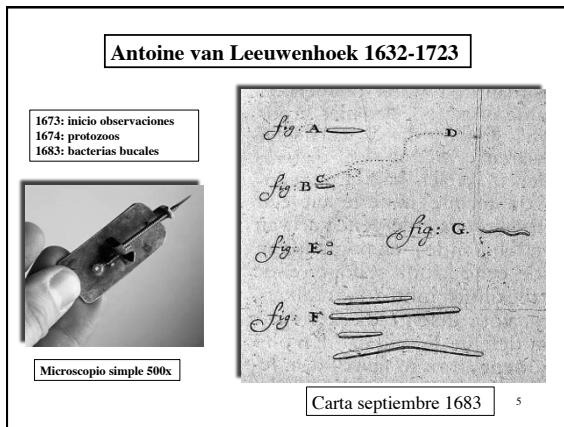
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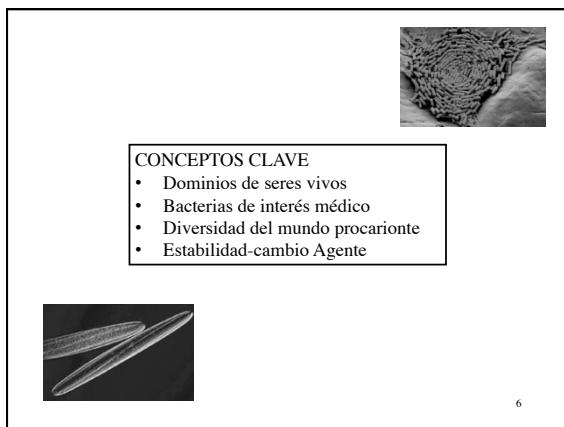
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**1. Dominios de seres vivos: Procariontes=Bacteria?**

Procarionte      Eucarionte

Figure 1

¿Procarionte=Bacteria?

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**Descubrimiento de un nuevo grupo de procariontes: los Archaea o Arquea**

Woese et al. 1978

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**ARN ribosomal: nuevo marcador evolutivo**

Carl Woese

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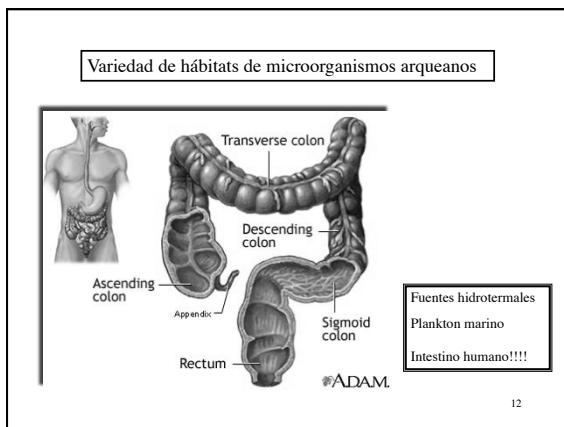
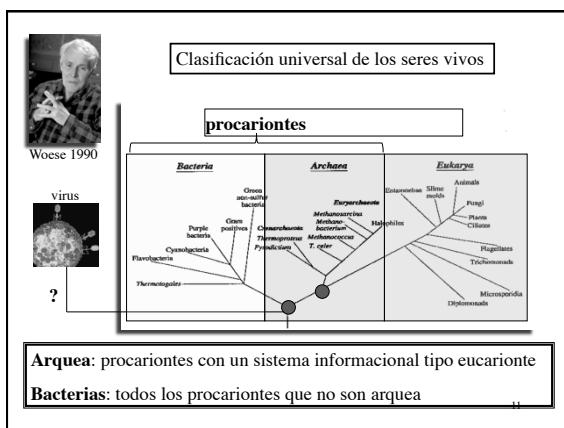
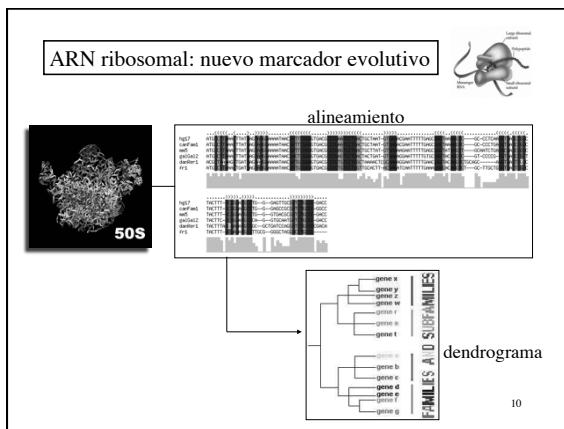
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**2. Dominio Bacteria: bacterias de interés médico**

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**Dominio Bacteria: coevolución agente-hospedero**

Bacterias ambientales: mar y suelos (Fotosíntesis, ciclos C, N, P, etc.)

En general no patógenos

Patógenos verdaderos

Microbiota normal (co-adaptadas)

oportunistas

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**Dominio Bacteria: principales grupos patogénicos**

Gram-positives

Gram-

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## Nomenclatura binomial: Taxonomía

- \* Dos palabras determinan la especie: género y epíteto específico
- \* Sufijos específicos por cada clase:  
“ales”: orden Pseudomonadales
- \* Nombres latinizados: pronunciación latina y no castellano (ch=k; gi=gui)
- \* Nombres deben escribirse en letra itálica o subrayados

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Phylum Proteobacterias

*Vibrio parahaemolyticus*

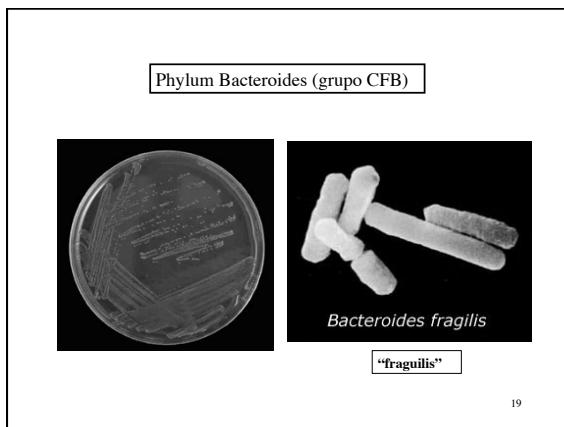
*Rickettsia spp.*

*Escherichia coli*  
Enterobacterias

*Helicobacter pylori*

“parahemolyticus”

“eskerikia”



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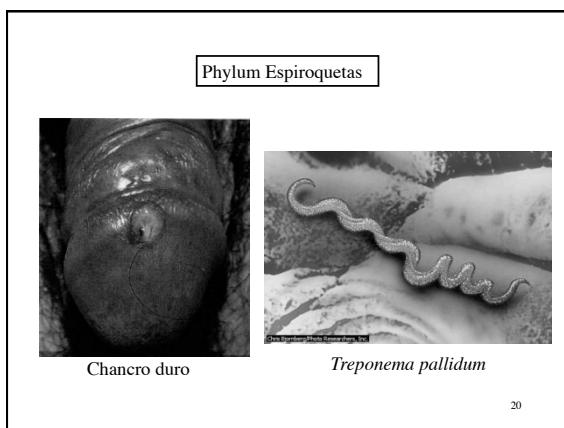
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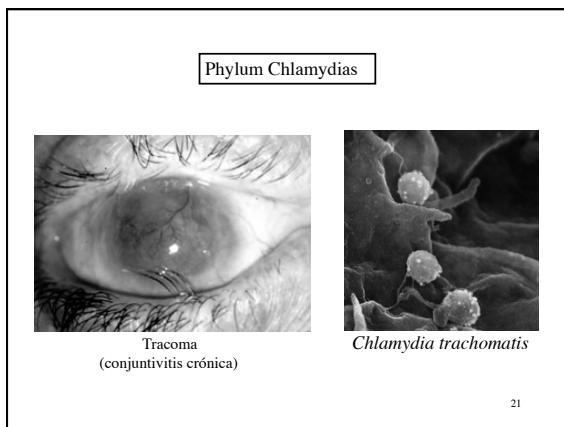
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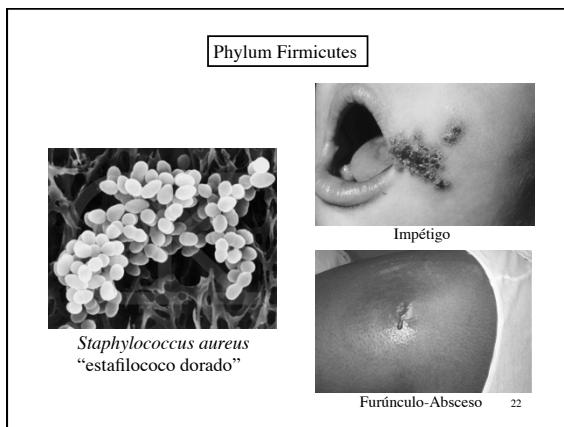
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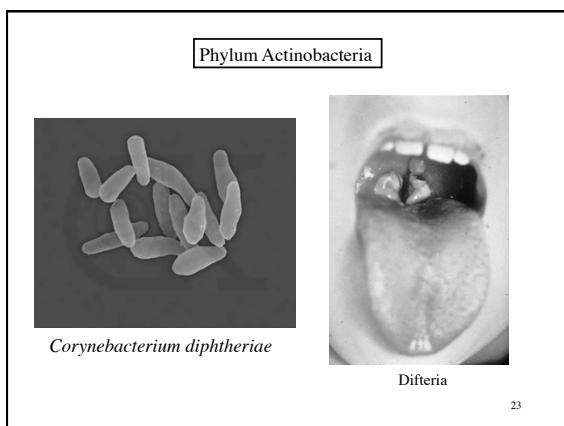
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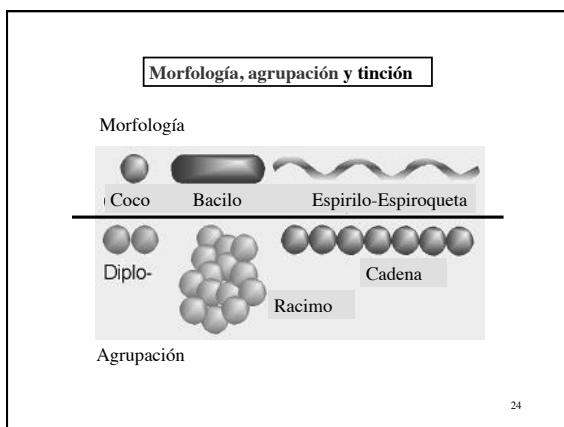
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**4. Morfología, agrupación y tinción**

Christian Gram (1853-1938)

Tinción de Gram (1853-1938)

Gram<sup>+</sup>

*Lactobacillus acidophilus*

*Streptococcus thermophilus*

Gram<sup>-</sup>

*Escherichia coli*

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**Dimensiones de procariontes de interés médico**

length in micrometers (μm)

0 2 4 6 8 10 12

*Mycoplasma genitalium* 0.4 μm

*Neisseria gonorrhoeae* 1.2 μm

*Staphylococcus aureus* 0.9 μm

*Escherichia coli* 1.5 μm

*Bacillus megaterium* 4 μm

< 5 μm

red blood-cell 8 μm

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**Estructura general de los procariontes**

nucleoide

MP

PG

citoplasma

n

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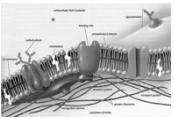
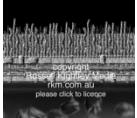
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**Función de envolturas bacterianas**

<b>Membrana celular</b>	<b>Pared celular</b>
<ul style="list-style-type: none"> <li>• Barrera de permeabilidad selectiva</li> <li>• Respiración celular</li> </ul>	<ul style="list-style-type: none"> <li>• Protección física</li> <li>• Protección contra el choque osmótico (G-: 2 atm; G+: 25 atm)</li> </ul>

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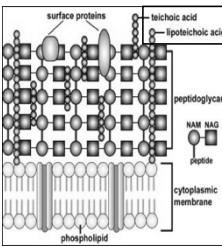


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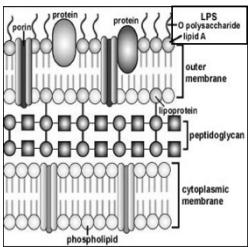


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**Principales tipos de pared celular**



Gram positivos



Gram negativos

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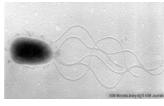


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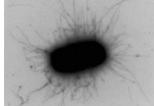
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**Principales apéndices bacterianos proteicos**



**FLAGELOS**

- Filamentos de proteína flagelina
- Grosor: 20 nm; Largo: ca. 15  $\mu$ m
- Visibles al MO con tinciones especiales
- Movilidad natatoria o en superficie



**FIMBRIAS (PILUS-PILI)**

- Filamentos de pilina: disposición perítrica
- Grosor: 5 nm; Largo: ca. 1.5  $\mu$ m
- Visibles sólo al microscopio electrónico
- Adherencia específica a mucosas

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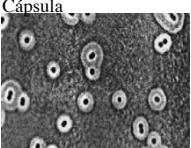


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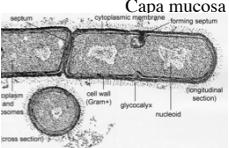


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**Exopolisacáridos: Glicocálix**



Cápsula



Capa mucosa

- Estructura densa que cubre la superficie bacteriana
- Función antifagocitaria

- Estructura laxa adherida a la bacteria
- Adherencia a materiales inanimados

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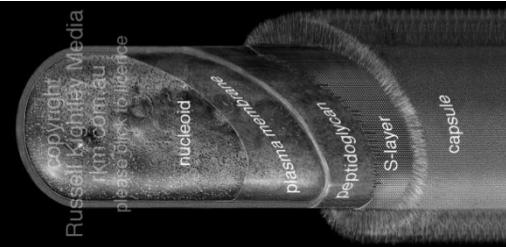


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**Resumen de Envolturas: MP, PG y cápsula**



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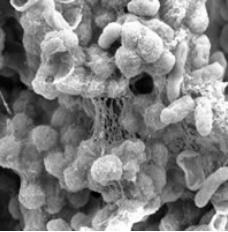


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**Exopolisacáridos: Biopelículas**





- Estructura polisacárida laxa intercelular (ej: celulosa)
- Adherencia a materiales inanimados

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Esporas bacterianas de importancia médica: endosporas

Microscopio electrónico

Microscopía óptica: Gram

3. Diversidad del mundo procarionte

12 phyla  
1987

36 phyla  
1997

80 phyla  
2004

no cultivables  
Cultivables (54)

El 2009 se describían > 100 phyla bacterianos!

3. Diversidad del mundo procariante

*Halococcus walsbyi*  
Grosor: 0.2  $\mu\text{m}$

*Epulopiscium* sp. 0.3 mm

*Gemmata obscuriglobus*  
Phylum Planctomycetes

#### 4. Estabilidad-Cambio

“Uno puede pensar el siglo 20 como la época en que llegó a su fin una de las más importantes revoluciones sociales de la historia, esto es, la virtual eliminación de las enfermedades infecciosas como un factor significativo en la vida humana”

History of Infectious Disease, 3th edition, 1962 (p. 18).

Sir Frank Mac-Farlane Burnet  
(1899-1985)  
Premio Nobel Medicina 1960



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#### 4. Estabilidad-Cambio: Estafilococo meticilino-R

**BBC NEWS** UK EDITION

Last Updated: Thursday, 24 February, 2005, 11:10 GMT

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## NHS superbug death rate doubles

The number of deaths from the superbug MRSA has been cited as a cause as has doubled in four years, official statistics show.

Health Office figures show that in 2003 MRSA was mentioned on 955 death certificates - up from 487 in 2000.

But the figures suggested some of the rise may be down to better reporting of the bug.

Other statistics revealed the number of HIV diagnoses seems to have levelled off after a decade of increases.

However, it was the MRSA figures which have proved most controversial.

Mortality rates were highest among older people with more men than women dying.

MRSA was involved in too many deaths in hospitals, and three out of 1,000 deaths in NHS nursing homes,

**66** No other country has seen the super bug infection rates that we have in Britain. **55**

Michael Howard

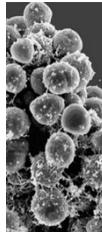
Q&A: MRSA



of the MRSA increase could be down to better reporting

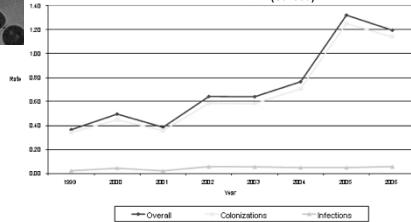
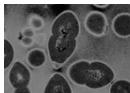


MRSA->VISA->VRSA



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#### 4. Estabilidad-Cambio: Enterococo vancomicina-R



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**4. Hipótesis de la Reina Roja: cambio constante del agente**

"Ahora, en este lugar, tú ves que para mantenerse en el mismo sitio, no puedes parar de correr"



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**4. Estabilidad-Cambio****RECORDAR SIEMPRE QUE:**

- Las bacterias intercambian material genético frecuentemente (Transferencia Genética Horizontal o TGH).
- Las bacterias se reproducen cada 20 min (promedio)

**CONSECUENCIAS:**

- Surgimiento de nuevas cepas con alto potencial patogénico (peste negra, cólera y otras epidemias).
- Aumento de fenómeno de resistencia a antibióticos



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**BIENVENIDOS AL MÓDULO DE BACTERIOLOGÍA-MICOLOGÍA****Bibliografía**

- Brock Biología de los Microorganismos, 10º edición 2004.
- Microbiología Médica, Murray et al., 5º edición 2006.
- Cazadores de Microbios, Paul de Kruif (editorial Porrúa)

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