

Bacteria and archaea

Commonalities and differences

Lateral gene transfer

Chloroplasts and mitochondria

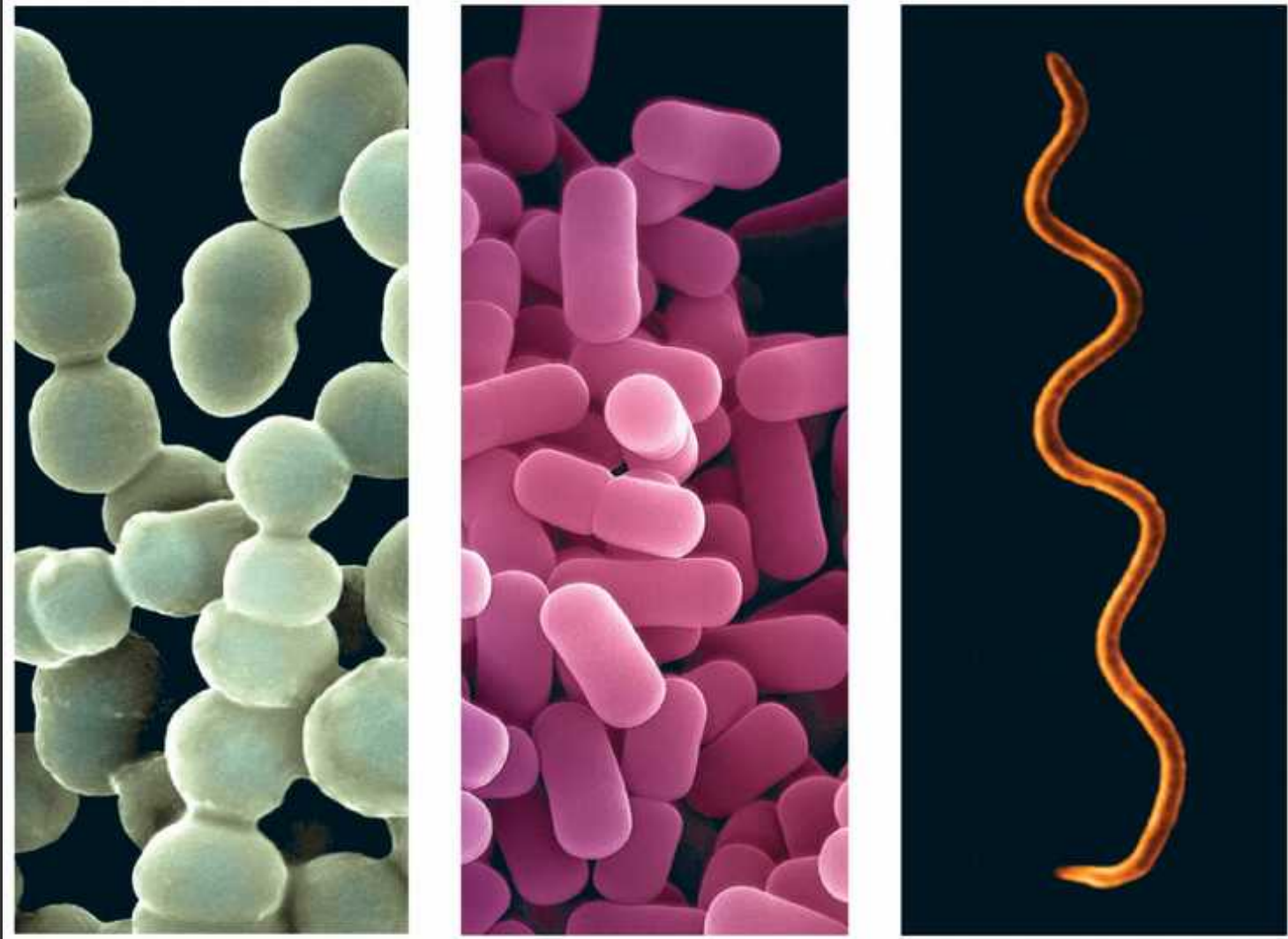
Symbioses

Metabolic cooperation

Global importance



Prokaryote cell shapes

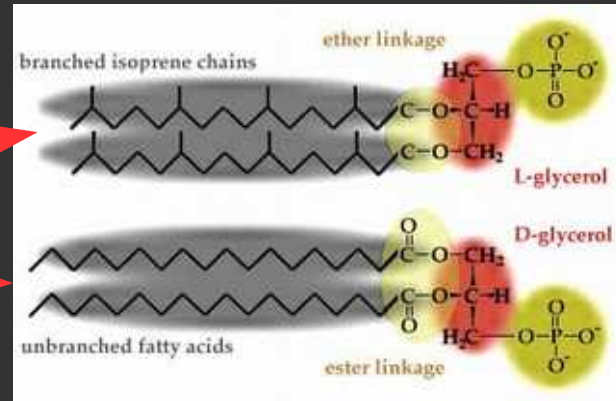
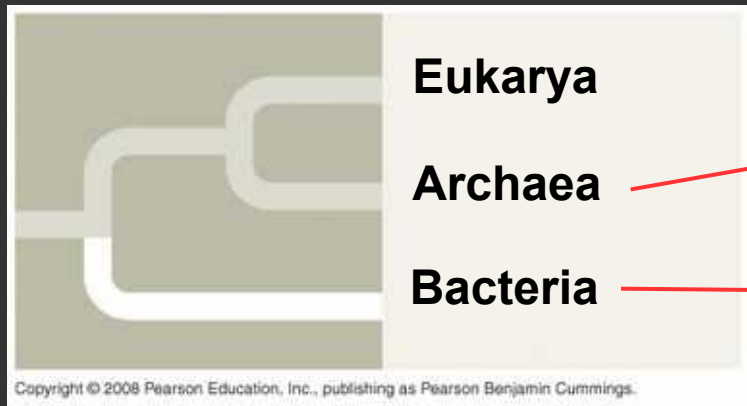


Spherical (cocci)

Rod-shaped (baccili)

Spiral

Prokaryotes: Two domains



no peptidoglycan

peptidoglycan

Cell membranes

Cell walls

Archaea have eukaryote-like ribosomes as well

Archaeal metabolic pathways: (what is missing?)

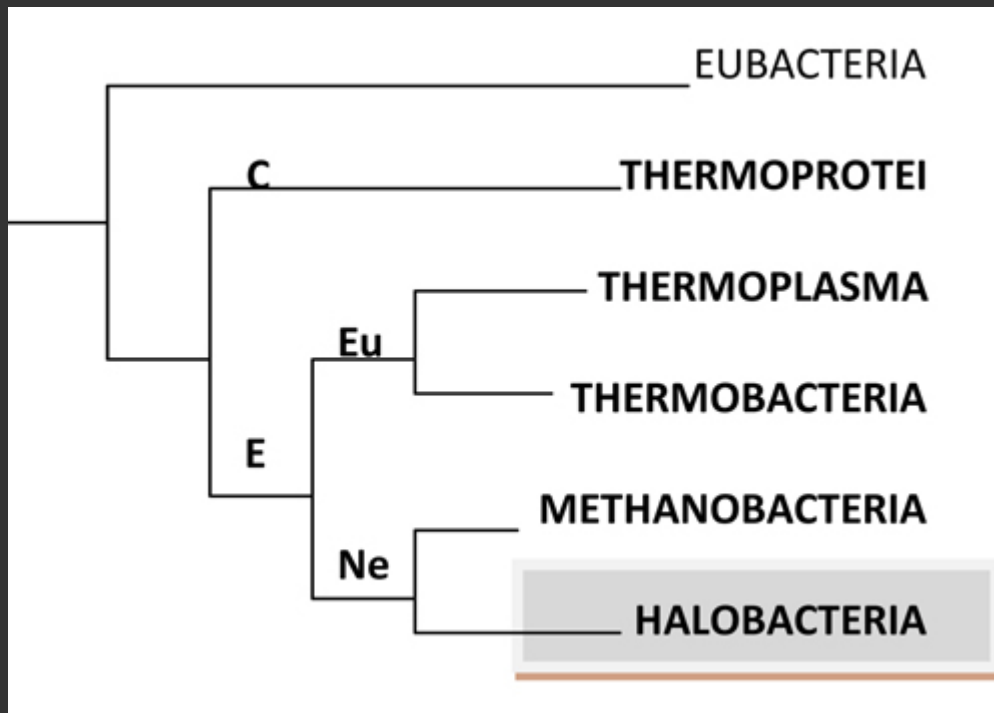
Photo-litho-hetero

Chemo-litho-auto

Chemo-litho-hetero

Chemo-organo-auto

Chemo-organo-hetero



Halobacteria (aren't bacteria!)

Don't use chlorophyll...
They use rhodopsins, the same
compound in animal eyes used to
detect light

Photo-litho-heterotrophs



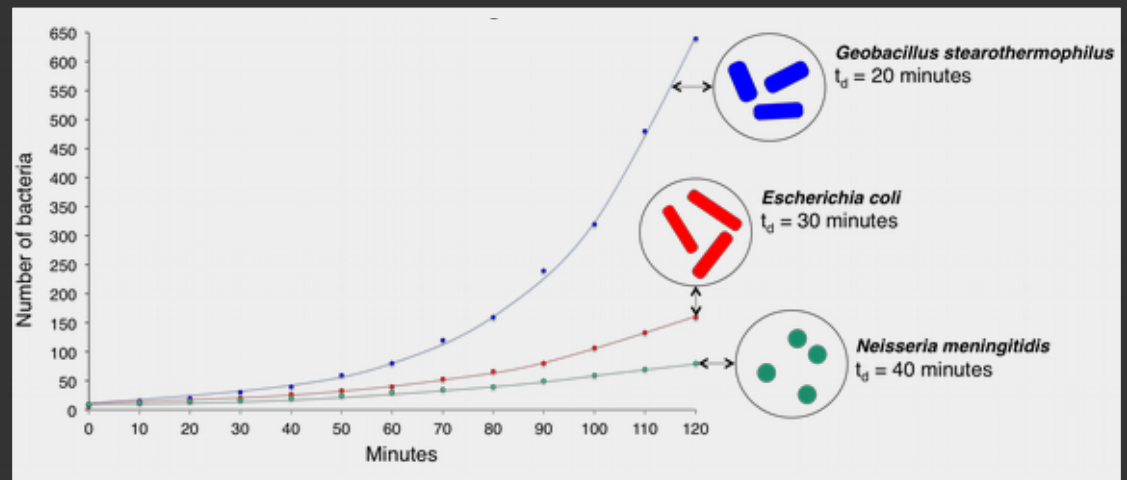
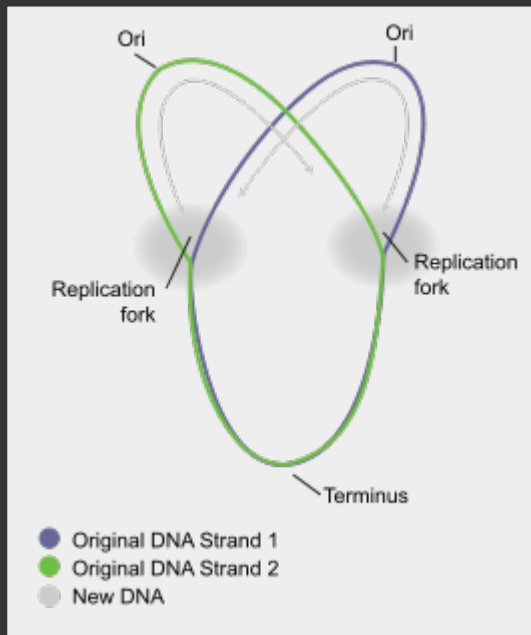
Common characteristics

(between bacteria and archaea)

Circular chromosome

Fast generation times

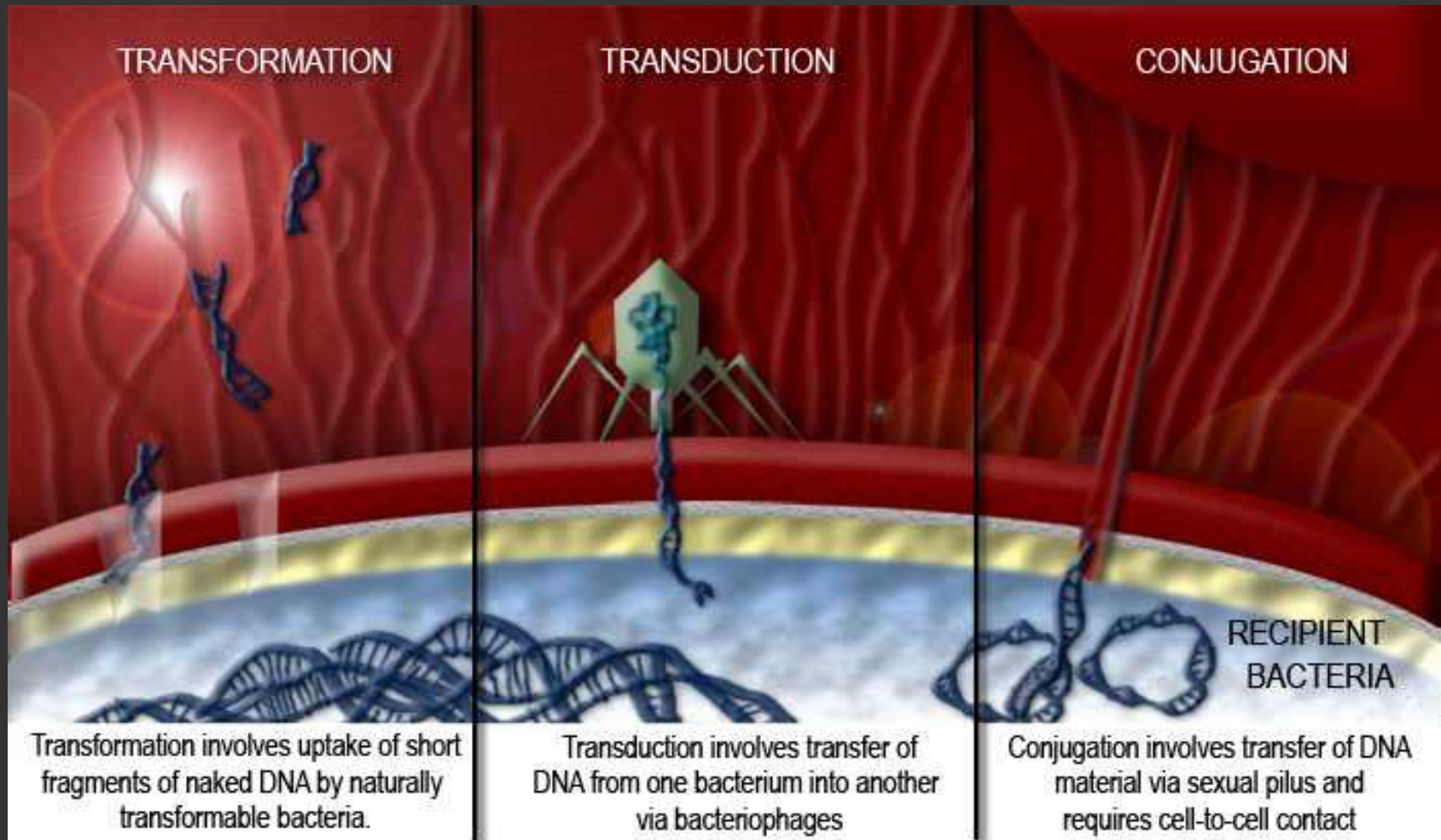
Low mutation rates (very good DNA polymerase proofreading activity)



How do they evolve so quickly if they mutate so rarely?

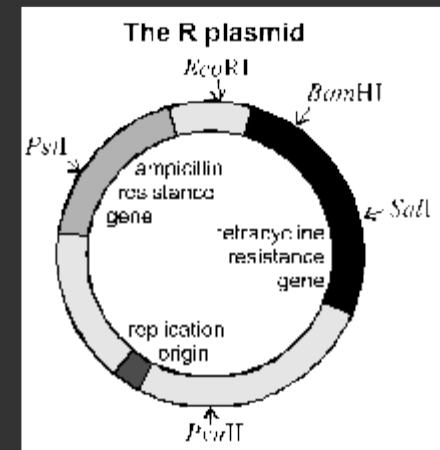


Lateral Gene Transfer (LGT)

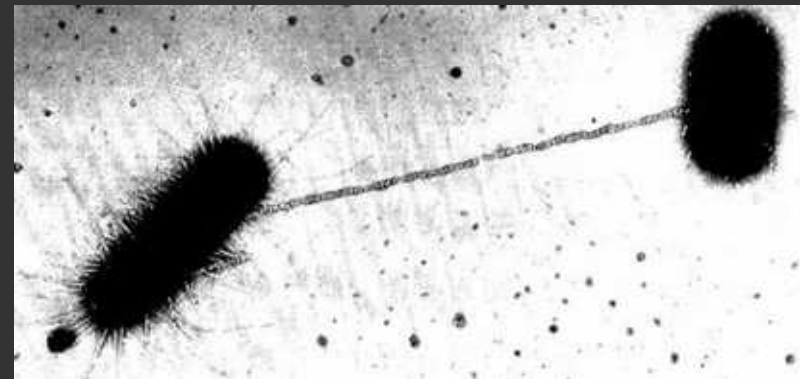


R and F Factors

R factor: a plasmid that contains code for resistance to stress (e.g., antibiotic resistance)



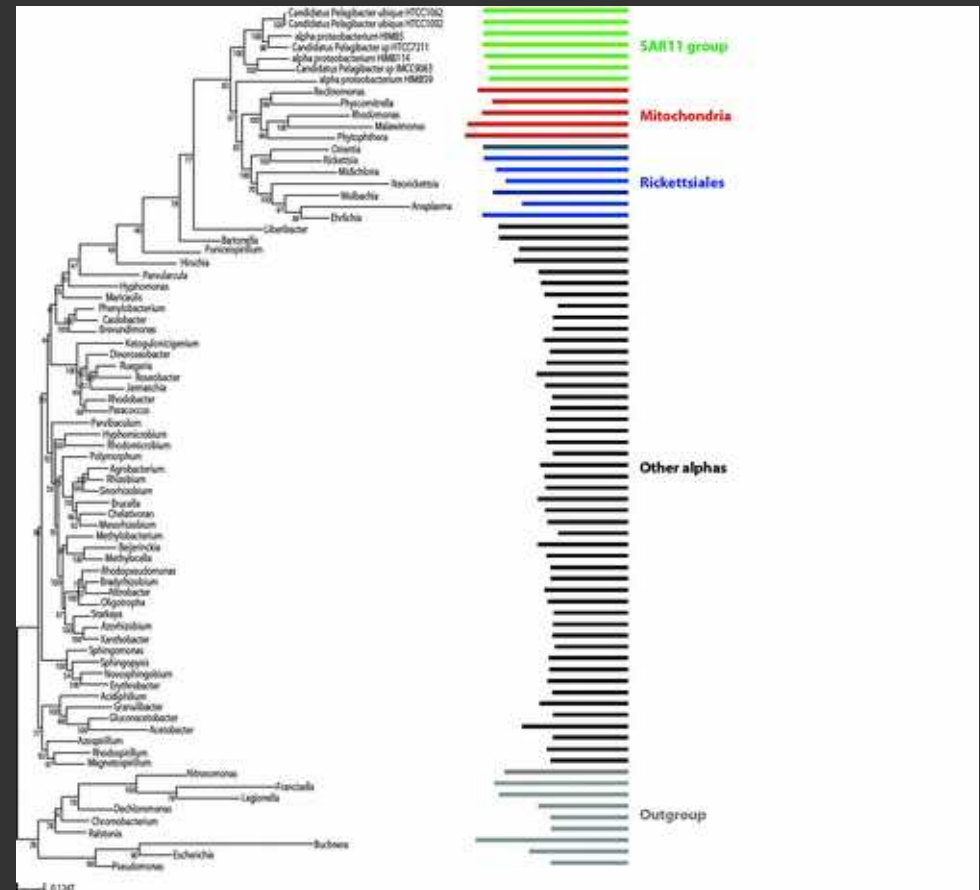
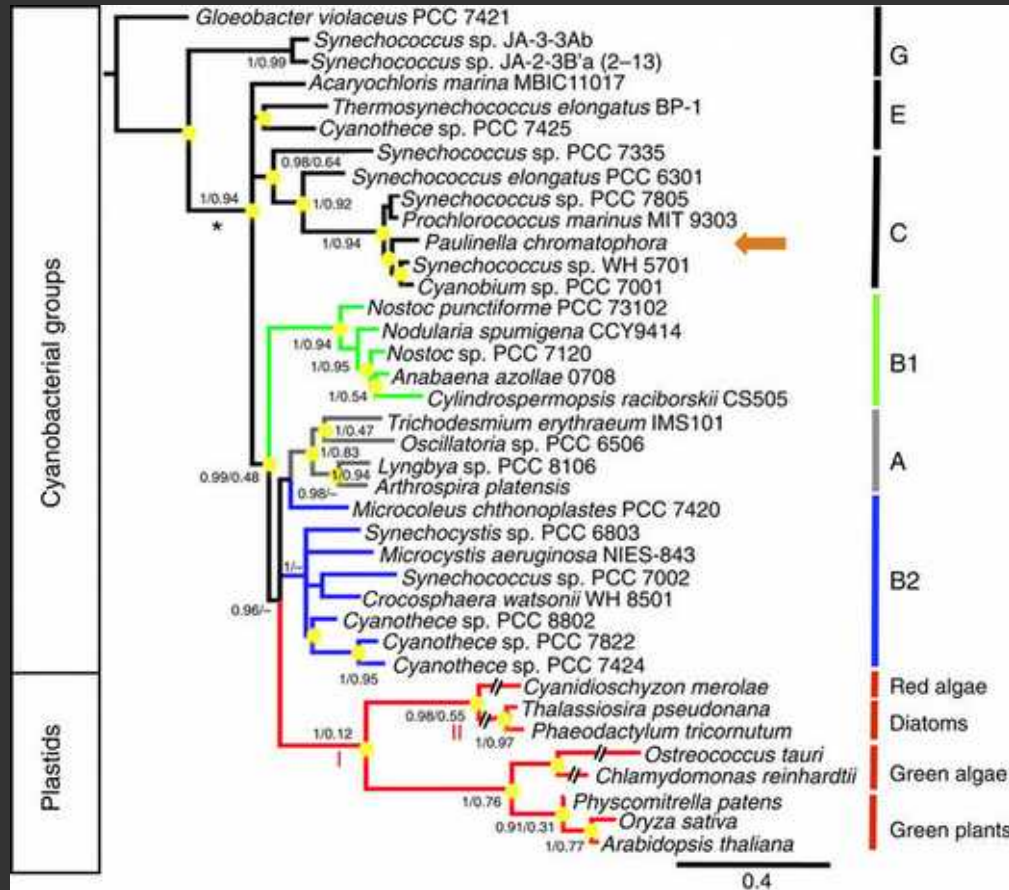
F factor: code that enables construction of sexual pilus for efficient plasmid transfers



Why is fertility factor so widespread?

Chloroplasts and Mitochondria

(Certain Cyanobacteria and α -Proteobacteria)



Symbiosis: A spectrum of cooperation

Table 14.1 **The Three Types of Symbiotic Relationships**

	Organism 1	Organism 2	Example
Mutualism	Benefits	Benefits	Bacteria in human colon
Commensalism	Benefits	Neither benefits nor is harmed	<i>Staphylococcus</i> on skin
Parasitism	Benefits	Is harmed	Tuberculosis bacteria in human lung

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A bacterial strain that causes a disease in its host is called a **pathogen**.

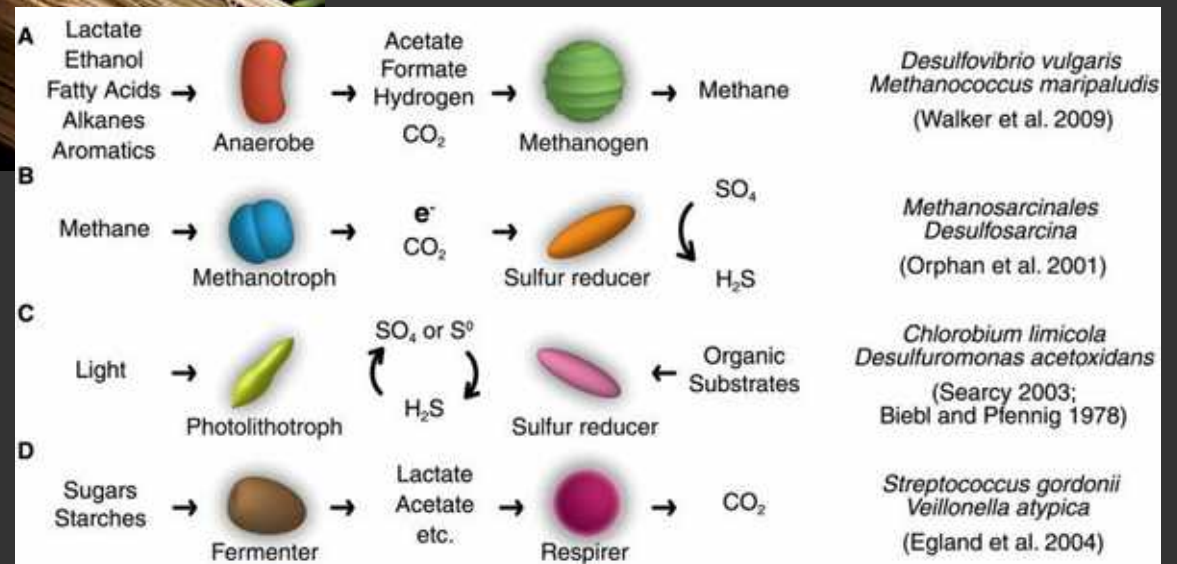
Metabolic cooperation



Microbial "consortia"

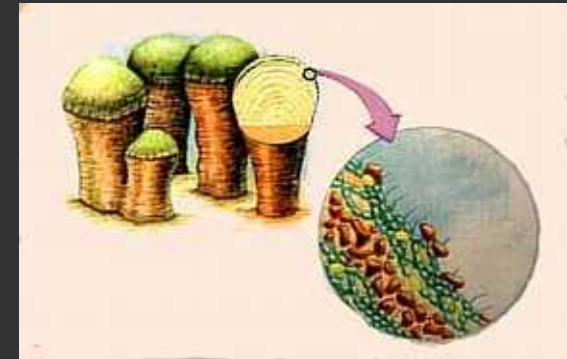
One person's garbage is another's treasure!

Allows microbial communities to perform functions that individual species cannot

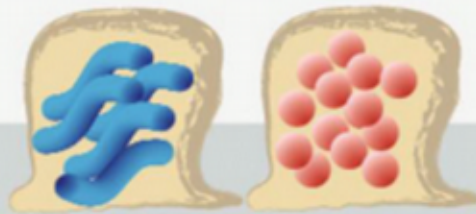




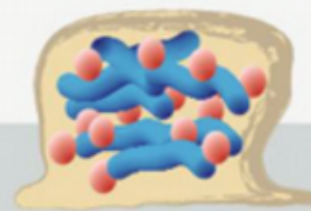
Stromatolites are
layered consortia



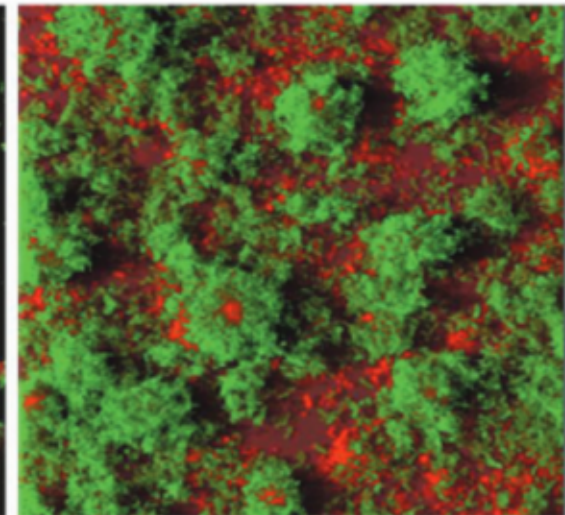
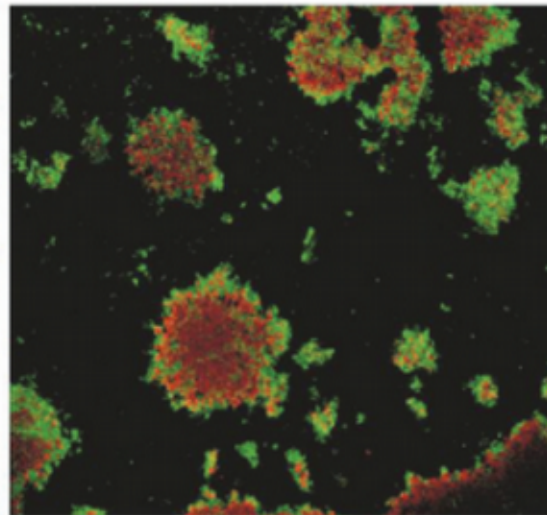
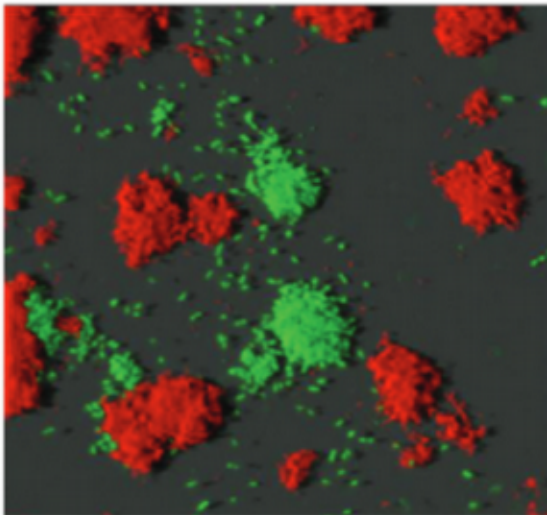
(a) Separate microcolonies



(b) Coaggregation



(c) Layering



Prokaryotes: So what?



Iron bacteria (bog iron)



Prokaryotes: So what?

Bioremediation

THE SCIENCES

Slick Solution: How Microbes Will Clean Up the Deepwater Horizon Oil Spill

Bacteria and other microbes are the only thing that will ultimately clean up the ongoing oil spill in the Gulf of Mexico

By David Biello on May 25, 2010  44

Prokaryotes: So what?

Bioprospecting



Applied and Environmental
Microbiology

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Appl Environ Microbiol. 2001 Apr; 67(4): 1529-1535.

doi: 10.1128/AEM.67.4.1529-1535.2001

PMCID: PMC92765

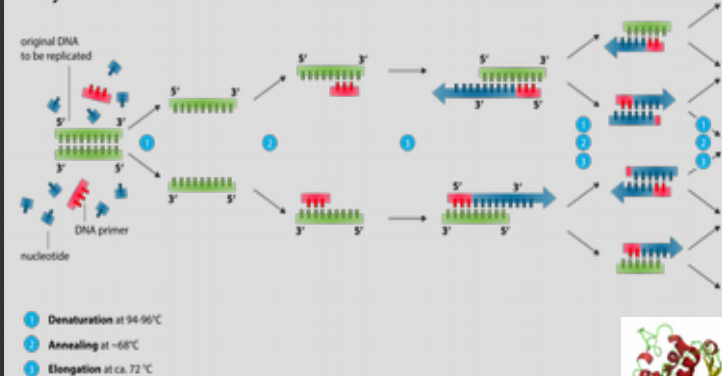
Cold-Adapted β -Galactosidase from the Antarctic Psychrophile *Pseudoalteromonas haloplanktis*

A. Hoyoux, I. Jennes, P. Dubois, S. Genicot, F. Dubail, J. M. François, E. Baise, G. Feller, and C. Gerday

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Polymerase chain reaction - PCR



Taq
polymerase:
from *T. aquaticus*

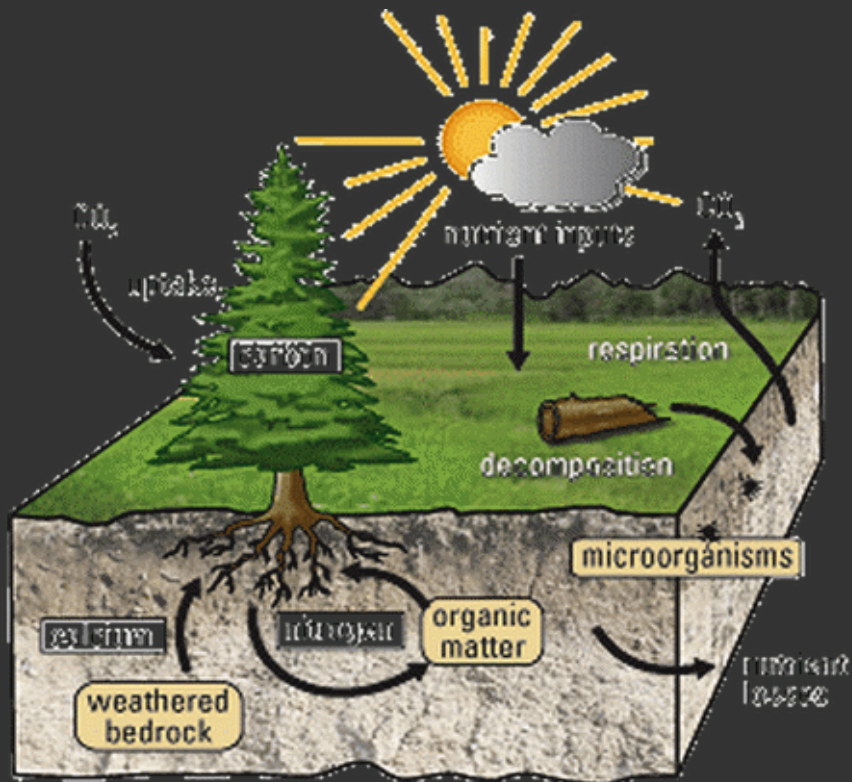
Streptomyces coelicolor



Source of antibiotic: Streptomycin

Prokaryotes: So what?

Nutrient cycling - Without it, we would all die



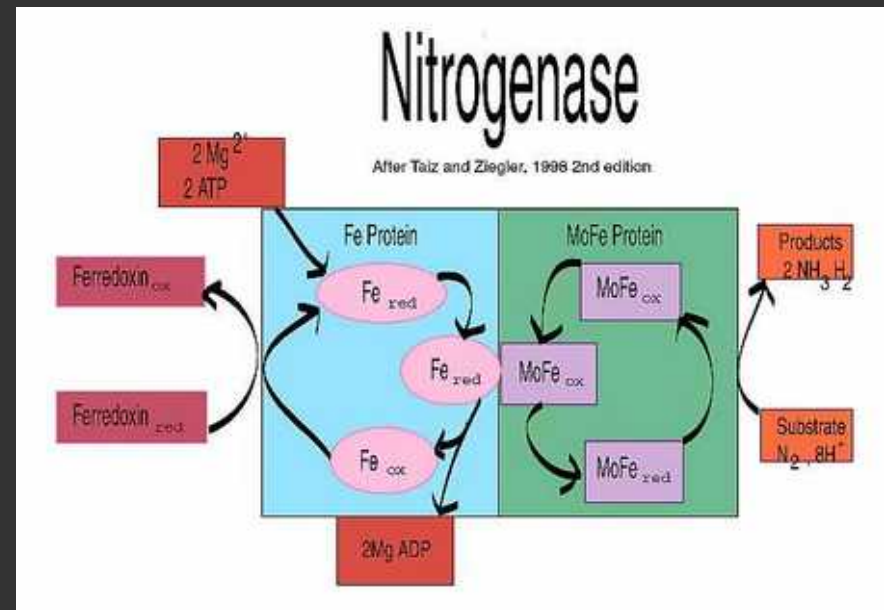
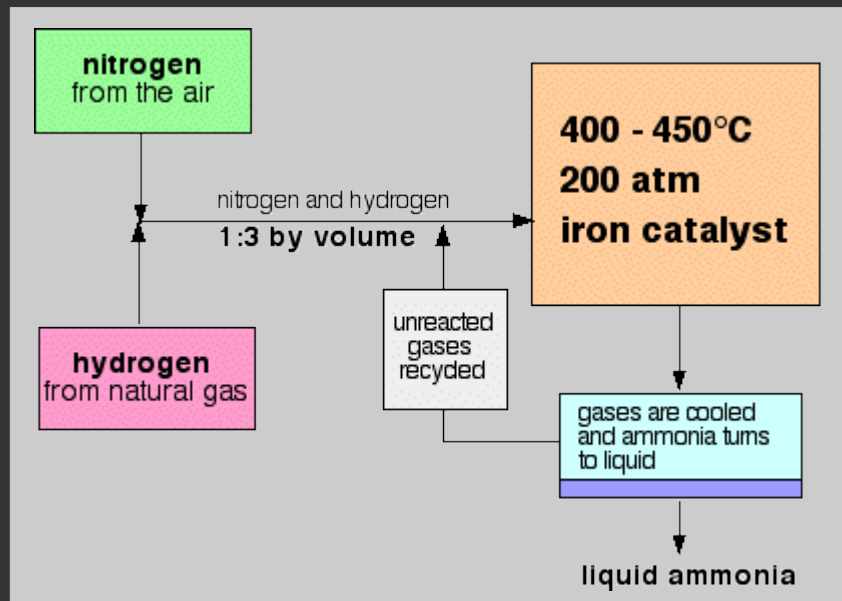
Nitrogen fixation

Haber process: Turn air into fertilizer

- 15% efficiency
- 80% of human N comes from this process
- 2% of the world's annual energy used to power it
- Directly linked to population explosion

N-fixing bacteria: Turn air into fertilizer

- 54-99% efficiency
- Basically, only source of plant-available N in areas not fertilized
- No energy costs to humans
- Not good enough to feed 9B people



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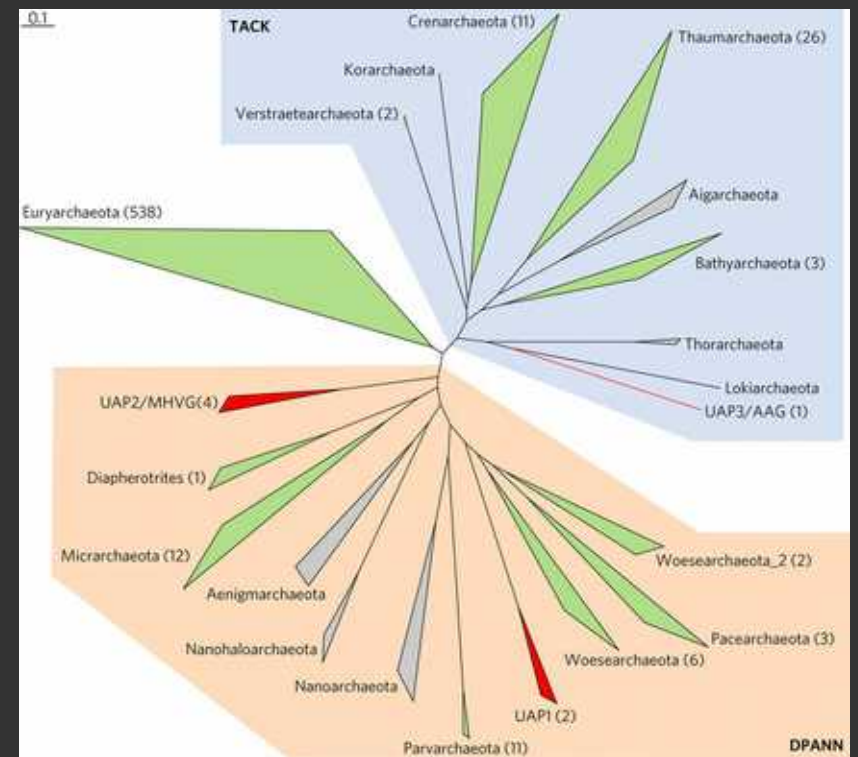
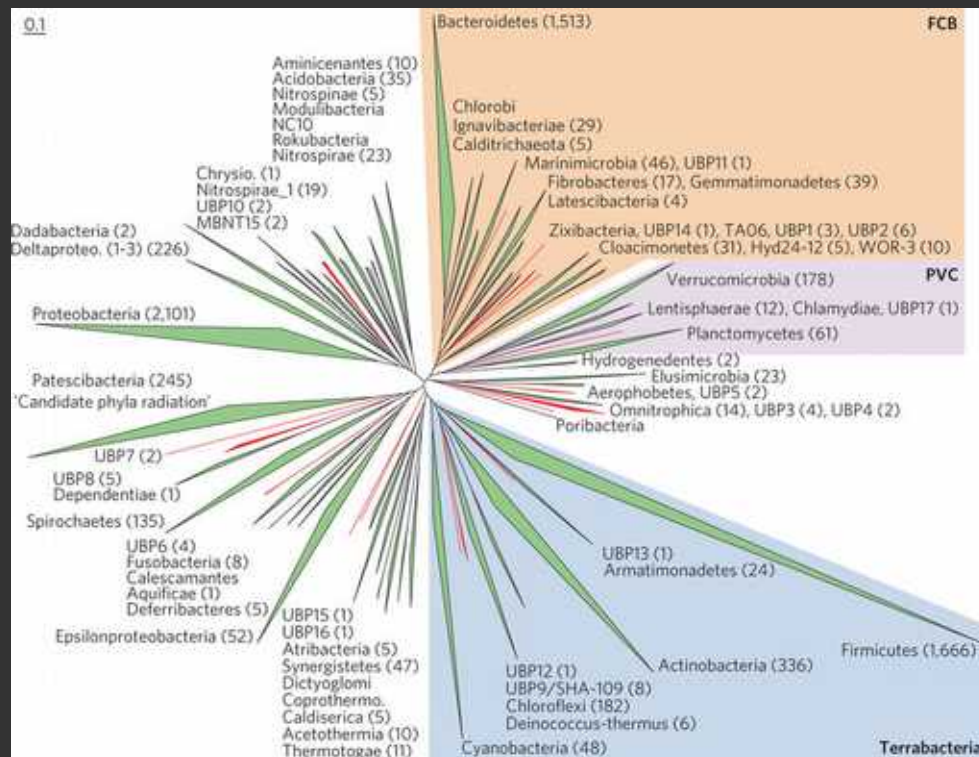
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Recovery of nearly 8,000 metagenome-assembled genomes substantially expands the tree of life

Donovan H. Parks, Christian Rinke, Maria Chuvochina, Pierre-Alain Chaumeil, Ben J. Woodcroft, Paul N. Evans, Philip Hugenholtz & Gene W. Tyson



Sep 11, 2017

