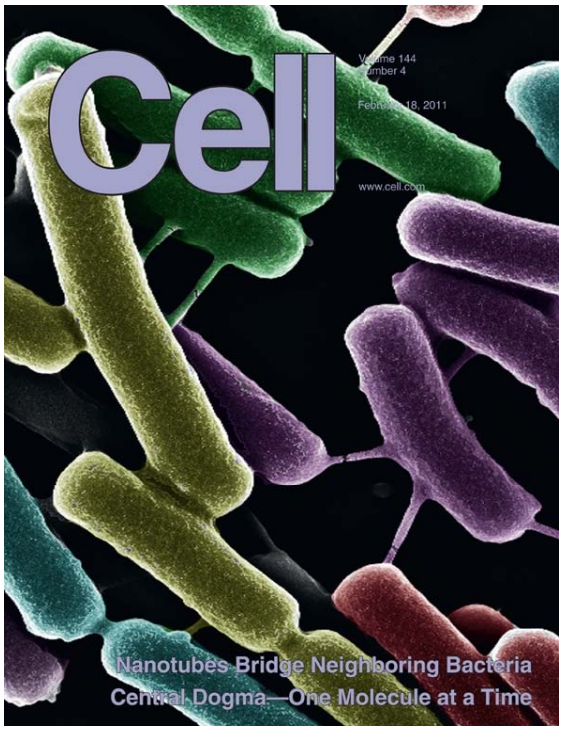
Breakthrough: Bacterial Nanotube Communication

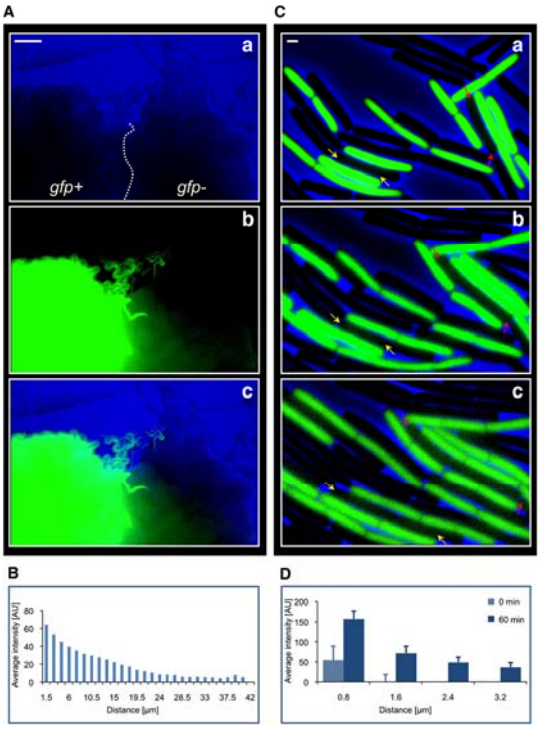
Bacterial Nanotubes

Dubey, G.P. and S. Ben-Yehuda. 2011. Intercellular nanotubes mediate bacterial communication. Cell **144**:590-600



Transfer of GFP

A. Mix of *B. subtilis* PY79(gfp$^-$) and SB444 (gfp$^+$)
B. Fluorescence in gfp$^-$ cells as a function of distance from gfp$^+$ cells
C. a. 0 min; b. 30 min; c. 60 min.
D. Fluorescence of gfp$^-$ cells as a function of distance from gfp$^+$ cells.

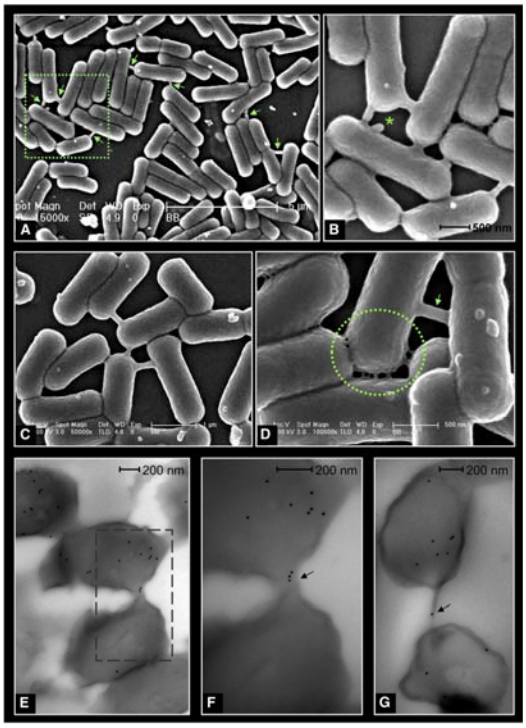


SEM: The Nanotubes

Nanotubes are obvious: arrows

Are they originally tiny: B dashed line area.

E. F. G. Gold conjugated anti-gfp Ab approach or are in nanotubes.



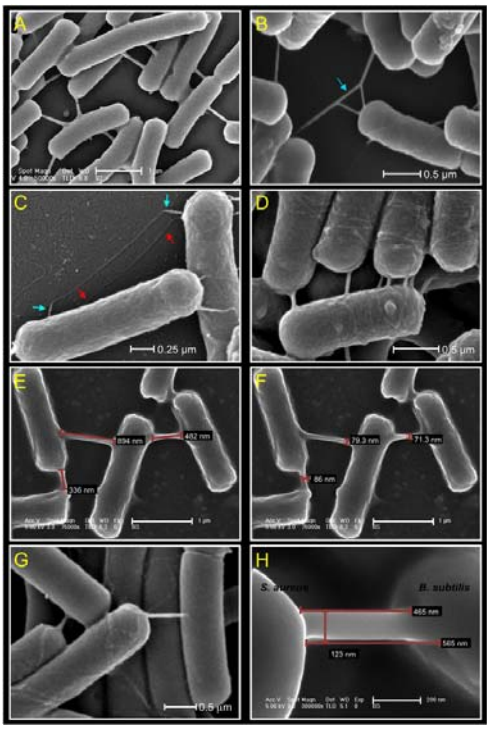
Look at These Tubes!

Nanotubes formed between:

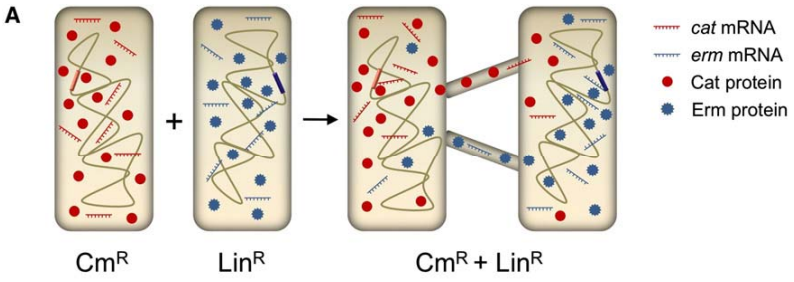
B. subtilis and *S. aureus*

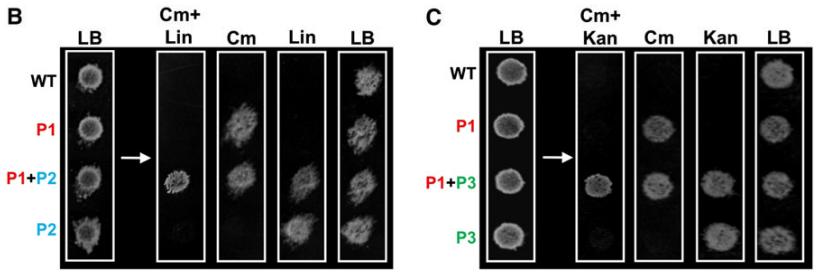
B. subtilis and *E. coli*

E. coli and *S. aureus*



Transient Non-hereditary Phenotype Transfer

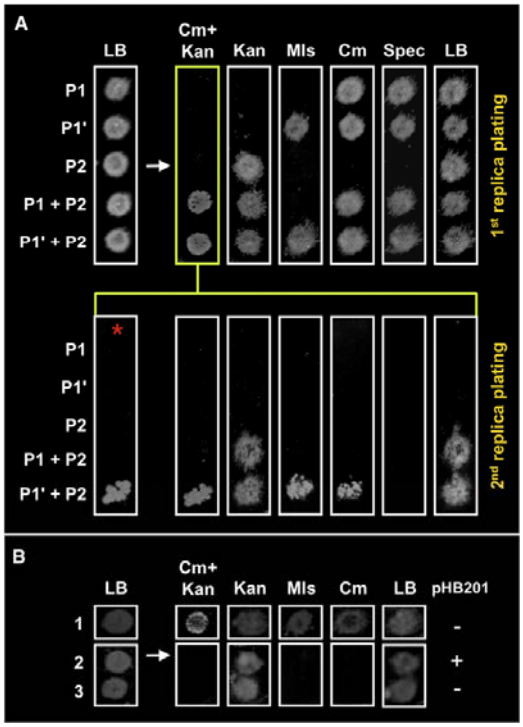




Plasmids Transfer in Nanotubes

Nonhereditary

Hereditary

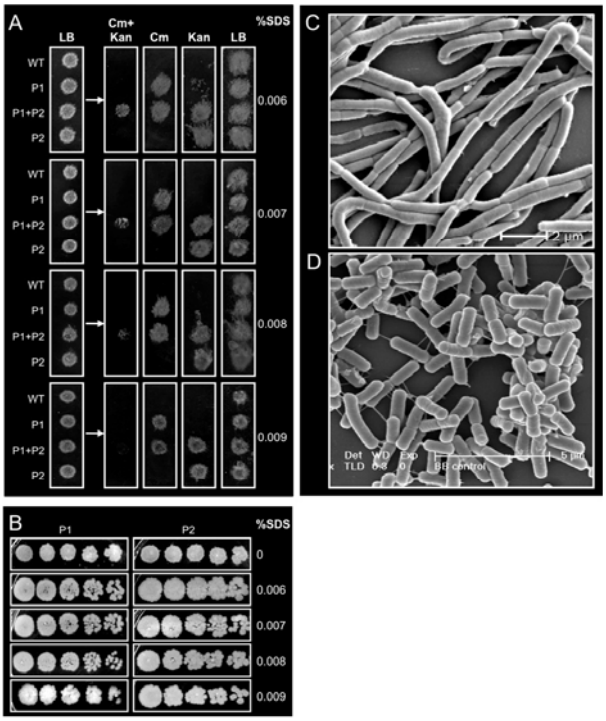


Frequency of plasmid transfer was 10^{-4} to 10^{-7}

Nature of Nanotubes: Effect of SDS

1. SDS at 0.009% allows *B. subtilis* to grow (A.. LB).
2. SDS at 0.009% stops nonhereditary transfer (P1+P2…Cm+Kan).
3. SDS does not increase Cm or Kan sensitivity: serial dilutions 3^{-6} to 3^{-10} (B)
4. SEM: no-nanotubes in 0.007% SDA (C) but nanotubes lacking SDS (D).

Thus nanotube transfer is SDS sensitive.



Bacterial Nanotubes

Transfer of CARGO or Signals or Both?

What is the chemical structure of the tube ?

How does the membrane fit in (get through wall peptidoglycan and into the tube) ?

What are the energetics ? Who drives what into whom ?

What is the relationship to the cytoskeleton ?