**URLs**

***Bacillus subtilis*:** http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=genomeprj&cmd=Retrieve&dopt=Overview&list_uids=76
**ComGA:** http://us.expasy.org/uniprot/P25953
**ComFA:** http://us.expasy.org/uniprot/P39145
**YwpH:** http://us.expasy.org/uniprot/P94590
**RecA:** http://us.expasy.org/uniprot/P16971
**RecN:** http://us.expasy.org/uniprot/P17894

HORIZONTAL GENE TRANSFER

# Coordinated uptake

Along with transduction and conjugation, transformation — the uptake of free DNA from the environment into the bacterial cytosol — is an important source of horizontal gene transfer. The Gram-positive bacterium *Bacillus subtilis* is one of ~40 different bacterial species that are naturally competent, that is, naturally capable of taking up DNA. At least 16 different proteins that are involved in DNA uptake have been identified in *B. subtilis*, ranging from components of the cell-surface competence pseudopilus to cytosolic proteins, the role of which in transformation is still unclear. However, until recently, there was little evidence on the localization of the DNA-transport apparatus. Now, reporting in *Cell*, two groups have examined the localization of both the transformation machinery and the cytosolic proteins that are involved in the recombination of exogenous DNA into the host bacterial chromosome.

In the first paper, Hahn *et al*. used fluorescence microscopy to look at the cellular location of ComGA, an ATPase that is required for assembly of the competence pseudopilus and DNA binding; ComFA, which is required for DNA transport but not DNA binding; and YwpH, which is thought to be a single-stranded DNA (ssDNA)-binding protein. The results showed that all three known competence proteins localized at the cell poles.

The connection between the polar localization of ComGA and YwpH and competence was then analysed, and the data indicate that the concentrations of ComGA and YwpH progressively increase at the poles and then decrease, and that this correlates with a rise and fall in competence, respectively. Finally, laser tweezer analysis was used to demonstrate that DNA uptake indeed occurs predominantly at the cell pole.

In the second paper, Kidane and Graumann looked at the localization of the ssDNA-binding ATPase RecA, which is involved in the recombination of ssDNA into a homologous DNA duplex, and RecN, an SMC family ATPase. Again using fluorescence microscopy, RecA foci were detected at the cell poles and were found to colocalize with ComGA. Timelapse microscopy showed that RecN oscillates between the two poles; however, when at the poles, RecN colocalizes with RecA and ComGA. The precise role of RecN in recombination was previously unknown — in this work, Kidane and Graumann show that RecN is an ATP-dependent ssDNA-binding protein. In addition, they discovered that RecA can form transient filaments at the poles expressing the competence machinery, suggesting that incoming ssDNA is transported to the nucleoid by these RecA 'threads'.

Together, these papers support the suggestion that the uptake of ssDNA by transformation is closely coordinated with recombination into the bacterial chromosome and is a spatially well defined process.

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## References and links

**ORIGINAL RESEARCH PAPERS** Hahn, J. *et al*. Transformation proteins and DNA uptake localize to the cell poles in *Bacillus subtilis*. *Cell* **122**, 59–71 (2005) | Kidane, D. & Graumann, P. L. Intracellular protein and DNA dynamics in competent *Bacillus subtilis* cells. *Cell* **122**, 73–84 (2005)
**FURTHER READING** Chen, I & Dubnau, D. DNA uptake during bacterial transformation. *Nature Rev. Microbiol.* **2**, 241–249