

## IN BRIEF

**BACTERIAL EVOLUTION****Resurrecting motility**

To further our understanding of the evolution of bacterial regulatory networks, Taylor, Mulley *et al.* examined the mutational events required to restore motility in a mutant strain of *Pseudomonas fluorescens* that lacks flagella owing to the deletion of the master regulator of flagellar synthesis FleQ. The authors cultured the mutant in spreading motility medium, which imposes strong selective pressure to restore motility, and found that the mutated bacteria had regained flagella within 96 hours. This adaptation occurred in two steps: first, bacteria acquired mutations that increased the intracellular levels of phosphorylated NtrC, a distant homologue of FleQ that regulates the expression of genes involved in nitrogen uptake; then, bacteria acquired switch-of-function mutations in NtrC. These switch-of-function mutations resulted in NtrC-mediated regulation of flagellar genes, whereas regulation of nitrogen uptake was lost. Thus, natural selection can rapidly rewire complex regulatory networks to facilitate bacterial adaptation.

**ORIGINAL RESEARCH PAPER** Taylor, T. B., Mulley, G. *et al.* Evolutionary resurrection of flagellar motility via rewiring of the nitrogen regulation system. *Science* **347**, 1014–1017 (2015)

**FUNGAL GENOMICS****A personalized symbiosis toolkit**

Saprotrophic fungi must degrade dead organic matter for survival, whereas other fungi have evolved a mycorrhizal symbiotic lifestyle that enables them to obtain carbon compounds from their plant partners. Kohler *et al.* analysed the evolution of mycorrhizal fungi by comparing 49 fungal genomes and showed that ectomycorrhizal (ECM) species, which do not penetrate the plant cell wall, have evolved repeatedly from diverse saprotrophic species owing to the convergent loss of several genes encoding plant cell wall-degrading enzymes (PCWDEs). By comparing mRNA expression in free-living and root-associated ECM species, they identified genes that are upregulated during symbiosis. A large proportion of these were orphan genes that are restricted to a single ECM species and have no homologues in other ECM species. Together, these data suggest that convergent evolution of ECM fungi involved not only the loss of PCWDEs but also the acquisition of a species-specific toolkit of symbiosis-associated genes.

**ORIGINAL RESEARCH PAPER** Kohler, A. *et al.* Convergent losses of decay mechanisms and rapid turnover of symbiosis genes in mycorrhizal mutualists. *Nature Genet.* <http://www.dx.doi.org/10.1038/ng.3223> (2015)

**BACTERIAL TOXINS****A signal for toxin production**

Toxigenic *Clostridium difficile* strains produce toxin A and toxin B, which have been implicated in pathogenesis; however, the molecular mechanisms regulating toxin production are elusive. Darkoh *et al.* now show that the Agr quorum sensing system has a role in toxin expression through the generation of a novel thiolactone signalling peptide. Purified fractions containing this peptide from *C. difficile* cultures and stool samples of infected patients stimulated toxin synthesis in both hypervirulent and non-hypervirulent *C. difficile* strains. In addition to the newly identified signalling peptide, components of the quorum sensing and response pathways were shown to be involved in toxin expression. Thus, this quorum signalling pathway may provide new avenues for the development of therapeutics that target *C. difficile*.

**ORIGINAL RESEARCH PAPER** Darkoh, C. *et al.* Toxin synthesis by *Clostridium difficile* is regulated through quorum signaling. *mBio* **6**, e02569-14 (2015)