IN BRIEF

SYMBIOSIS

The root of a new interkingdom interaction

Symbiotic rhizobial bacteria and legumes have evolved complex signal exchange mechanisms that enable bacteria to penetrate the plant root and develop root nodules, where bacteria fix nitrogen. Now, Ren, Wang et al. uncover a new signalling mechanism by which bacteria regulate root nodulation. The authors found that tRNA-derived small RNA fragments (tRFs) from the rhizobium *Bradyrhizobium japonicum* modulate nodule numbers in the soybean *Glycine max* by hijacking the host RNAi machinery and regulating host gene expression. Five host genes involved in root hair and plant development were found to be regulated by tRFs, and silencing the tRFs or overexpressing their targets repressed nodule formation. By contrast, repression of the targets through miRNAs identical to the tRFs or CRISPR–Cas knockout promoted nodulation. These findings provide a new mechanism that could be exploited to enhance nodulation in legumes.

ORIGINAL ARTICLE Ren, B., Wang, X. et al. Rhizobial tRNA-derived small RNAs are signal molecules regulating plant nodulation. *Science* **365**, 919–922 (2019)
RELATED ARTICLE Poole, P., Ramachandran, V. & Terpolilli, J. Rhizobia: from saprophytes to endosymbionts. *Nat. Rev. Microbiol.* **16**, 291–303 (2018)

ANTIMICROBIALS

Metabolic state matters for antibiotic lethality

Bactericidal antibiotics kill pathogens and understanding the mechanisms of antibiotic lethality is important for combatting persistent infections. Both the growth rate and metabolic state of cells affect antibiotic lethality, but they are interrelated as growth affects metabolism and vice versa. Lopatkin et al. investigated the relative contribution of growth and metabolic state to antibiotic lethality by measuring growth rate and metabolism across a range of conditions (nine drugs of different classes, and diverse Gram-positive and Gram-negative bacteria) in which growth and metabolism were coupled and uncoupled (conditions in which only growth is nutrient-limited). The authors found that metabolic state and ATP levels at the time of treatment are more accurate predictors of lethality than growth rate, and determined a critical ATP threshold below which antibiotic lethality is negligible. These findings suggest that antibiotics will kill non-growing bacteria if metabolism is stimulated.

ORIGINAL ARTICLE Lopatkin, A. J. et al. Bacterial metabolic state more accurately predicts antibiotic lethality than growth rate. *Nat. Microbiol.* https://doi.org/10.1038/s41564-019-0536-0 (2019)

VIRAL INFECTION

A close-up of respiratory syncytial virus replication

Respiratory syncytial virus (RSV) is a leading cause of lower respiratory tract infection in infants and older persons, yet no vaccine is available. Thus, the development of effective RSV inhibitors is an active area of research. An attractive target for antiviral development is the viral RNA polymerase complex consisting of the large protein (L) and the phosphoprotein (P); however, structures of L and P have remained elusive. Now, Gilman et al. report a 3.2 Å cryo-electron microscopy structure of L bound to tetrameric P, providing atomic-level insights into transcription and replication of the RSV genome. For example, the P tetramer binds L in an unusual tentacular arrangement, with each monomer adopting a different conformation. The structure also explains inhibitor escape mutants and mutations that arise in live-attenuated vaccine candidates. Furthermore, it provides a new avenue of exploration for understanding RSV transcription and replication, and should aid in RSV drug development.

ORIGINAL ARTICLE Gilman, M. S. A. et al. Structure of the respiratory syncytial virus polymerase complex. *Cell* https://doi.org/10.1016/j.cell.2019.08.014 (2019)

BACTERIAL PHYSIOLOGY

Commensal defence

Neisseria gonorrhoeae, a sexually transmitted pathogen, is a major global public health concern owing to the rapid emergence of multi-drug resistant strains and the absence of a vaccine. The *Neisseria* genus comprises pathogenic *N. gonorrhoeae* and related non-pathogenic commensal species that colonize human mucosal surfaces. Commensal bacteria can inhibit colonization of pathogens by protein-based mechanisms or nutrient competition. Based on those observations and because *N. gonorrhoeae* infects the same niches as commensal *Neisseria* species, Kim et al. hypothesized that commensal *Neisseria* antagonize *N. gonorrhoeae*. In their study, the authors report that the human commensal *Neisseria elongata* kills *N. gonorrhoeae* through a DNA-mediated mechanism.

First, they showed that *N. elongata* kills *N. gonorrhoeae* when the two species are cultured together, whereas *N. elongata* viability is unaffected by the pathogen. This finding was confirmed in an in vivo mouse model of *N. gonorrhoeae* lower genital tract infection where the presence of *N. elongata* accelerates the clearance of the pathogen. Cell-free supernates of *N. elongata* kill *N. gonorrhoeae*, which indicated that a component released by the commensal is responsible for the killing activity. Further experiments showed that the toxic compound released into the medium is *N. elongata* DNA.

Neisseria species are naturally competent and readily take up DNA. The uptake of DNA involves the type IV pilus-associated protein ComP and the type IV pilus retraction motor PilT. The authors showed that *N. gonorrhoeae comP* and *pilT* deletion mutants are resistant to killing by *N. elongata* DNA. This, together with the finding that *N. elongata* does not accelerate the clearance of *N. gonorrhoeae comP* mutants in the mouse,

PARASITE DEVELOPMENT

The cat is out the bag about *Toxoplasma* host range

The parasite *Toxoplasma gondii* has a complex life cycle that involves sexual reproduction in the intestine of cats. Although other animals and humans can be infected, they only serve as intermediate hosts in which asexual reproduction occurs, but it can have severe consequences for the host, for example, leading to fetal complications in pregnant women. Little has been known about the factors that restrict sexual reproduction to cats so far; such knowledge could help to develop strategies to prevent shedding of infectious parasites from cats. A new study now finds that *T. gondii* relies on linoleic acid, which is abundant in the cat gut, for sexual development.

When *T. gondii* infects cats, it invades the intestinal epithelium

Credit: Sergey Zaikov / Alamy Stock Photo