



# Rachel Wheatley, DPhil

Biology

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Born in 1993 in Devon, United Kingdom

Studied Molecular Biology and Biochemistry at the University of Durham and Biology at the University of Oxford

FELLOWSHIP

College for Life Sciences

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## ARBEITSVORHABEN

### Determinants of Success in the Ecosystem of the Lungs

The lungs can be considered an ecosystem. From birth, the lungs are continually exposed to microorganisms. They host a diversity of microorganisms, collectively known as the microbiome, both in healthy and in diseased states. It is fascinating to think that the concept of a lung microbiome is a relatively new one; the lungs have historically been considered a sterile environment. We know now that a healthy lung can contain common key microbiome members, and that the lung microbiome and other environmental factors may in fact play a fundamental role in determining an individual's susceptibility to respiratory disease. The focus of my research is to understand how a single pathogen species is able to emerge in a lung microbiome, and to characterise the genetic and metabolic determinants of this success. I am especially interested in the opportunistic pathogen *Pseudomonas aeruginosa*, which is a major cause of healthcare-associated respiratory infection. During my stay at the Wissenschaftskolleg, I would like to explore how understanding bacterial metabolism can help advance pathogen treatment strategies. Successful infection of a human host is dependent on multiple pathogen behaviours, including successful resource competition, virulence factor production, and antibiotic and host immune evasion. Success of these behaviours can be linked to bacterial metabolism, and investigating metabolism can help identify metabolites or pathways with the potential to suppress pathogens. Identifying potential therapeutic targets given the wide range of environmental variables and metabolic targets remains a significant challenge, however, which high-throughput metabolic screening approaches and computational metabolic models have tried to overcome. This explorative work will form an important cornerstone for directing future studies I wish to approach. Outside of these interests, my additional research enthusiasms include antibiotic resistance evolution, transposon-based functional genomics approaches, and phage defence mechanisms.

## Recommended Reading

Wheatley, Rachel M., Brandon L. Ford, Li Li, Samuel T. N. Aroney, Hayley E. Knights, Raphael Ledermann, Alison K. East, Vinoy K. Ramachandran, and Philip S. Poole (2020). "Lifestyle Adaptations of Rhizobium from Rhizosphere to Symbiosis." *Proceedings of the National Academy of Sciences* 117, no. 38: 23823-23834.  
<https://doi.org/10.1073/pnas.2009094117>.

Wheatley, Rachel M., and R. Craig MacLean (2020). "CRISPR-Cas Systems Restrict Horizontal Gene Transfer in *Pseudomonas aeruginosa*." *The ISME Journal*. <https://doi.org/10.1038/s41396-020-00860-3>.

Wheatley, Rachel, Julio Diaz Caballero, Natalia Kapel, Fien H. R. de Winter, Pramod Jangir, Angus Quinn, Ester del Barrio-Tofiño, et al. (2021). "Rapid Evolution and Host Immunity Drive the Rise and Fall of Carbapenem Resistance during an Acute *Pseudomonas aeruginosa* Infection." *Nature Communications* 12: 2460.

<https://doi.org/10.1038/s41467-021-22814-9>.

# Die Party in der Petrischale und draußen: Wie können wir Bakterien und ihre Genome verstehen?

Bakterien sind überall – in unserem Körper, im Erdreich und sogar in hydrothermalen Spalten. Sie sind an enorm vielen Prozessen beteiligt – von Krankheit und Gesundheit über Nahrungsproduktion und den Sauerstoffeintrag in die Atmosphäre bis hin zur Produktion von Insulin, das sie wie kleine Zelfabriken herstellen. Als Mikrobiologin gilt mein Interesse dem Verständnis von Bakterien und den entscheidenden biologischen Prozessen, die sie steuern.

Ein guter Ausgangspunkt für das Verständnis von Bakterien ist das Genom, das im Grunde ein „Codebuch“ aller Möglichkeiten ist, die einer bakteriellen Zelle zur Verfügung stehen. Wodurch wird bestimmt, wie dieses Genom beschaffen ist? Und in Anbetracht all dieser Möglichkeiten – wie finden wir heraus, wie es tatsächlich genutzt wird? Mein Vortrag dreht sich im Wesentlichen um diese beiden Fragen und ich zeige anhand von Beispielen meiner bisherigen Arbeit, wie wir sie angehen können. Ich erkunde die „Inputs und Outputs“ der bakteriellen Genomevolution und lege dar, wie wir diese Prozesse im klinischen Rahmen untersuchen können: in den Lungen von Intensivpatienten. Anschließend befasse ich mich mit der Frage, was Genom und Funktion miteinander verbindet. Ich erörtere dieses Problem am Beispiel von Leguminosen und untersuche die Mechanismen, die der symbiotischen Stickstofffixierung zugrunde liegen.

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## PUBLIKATIONEN AUS DER FELLOWBIBLIOTHEK

Wheatley, Rachel (Palo Alto, Calif.,2022)

Understanding the impacts of bacteriophage viruses : from laboratory evolution to natural ecosystems

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=183322471X>

Wheatley, Rachel (Reading,2022)

Fitness costs of CRISPR-Cas systems in bacteria

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1814900632>

Wheatley, Rachel (Washington, DC [u.a.],2021)

Metabolic control of nitrogen fixation in rhizobium-legume symbioses

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=177986969X>

Wheatley, Rachel ([London],2021)

Rapid evolution and host immunity drive the rise and fall of carbapenem resistance during an acute Pseudomonas aeruginosa infection

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1762667568>

Wheatley, Rachel (Basingstoke,2021)

CRISPR-Cas systems restrict horizontal gene transfer in Pseudomonas aeruginosa

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1762664836>

Wheatley, Rachel (Washington, DC,2020)

Lifestyle adaptations of Rhizobium from rhizosphere to symbiosis

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1762666057>

Wheatley, Rachel (Oxford,2018)

Mechanisms of bacterial attachment to roots

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=177987099X>

Wheatley, Rachel (Washington DC,2017)

Rôle of O<sub>2</sub> in the growth of Rhizobium leguminosarum bv. viciae 3841 on glucose and succinate

<https://kxp.k1oplus.de/DB=9.663/PPNSET?PPN=1779872089>