PROJECT TITLE: From microbial growth to environmental adaptation: why do bacteria make membrane-spanning lipids?

Project Science Theme: Earth Science and Hazards
Project keywords: Microbes, environment, lipids, adaptation

Lead Institution: University Bristol
Lead Supervisor: Associate Professor Bernhard David A. Naafs, Bristol, Chemistry
Co-Supervisor: Ivana Gudelj, University of Exeter, Department of Biosciences

Project Enquiries: david.naafs@bristol.ac.uk

Webpage: https://www.bristol.ac.uk/chemistry/research/ogu/

Project description

Microorganisms continually adjust their physiology in response to changing environments, but how these responses translate into fitness and persistence in natural populations remains poorly understood. Membrane-spanning lipids in bacteria provide a striking example. These unusual lipids occur widely in the environment and are important for palaeoclimate proxies, yet why some bacteria invest substantial energy in producing them remains unresolved.

This interdisciplinary PhD will test a new hypothesis: that microbial growth rate provides a common physiological link between environmental conditions and the production of membrane-spanning lipids. Rather than individual environmental variables directly determining lipid composition, temperature, nutrients and other environmental conditions may alter growth, which in turn determines investment in these costly membrane structures.

The results will provide fundamental insights into pathways of microbial adaptation, explains occurrence of these lipids in the environment, and their use in palaeoclimate proxies.

The student will combine microbial culture experiments with lipid analysis to quantify relationships between environment, growth, and membrane composition. Crucially, they will then investigate what these individual-level relationships mean at ecological and evolutionary scales. Working across Bristol and Exeter, they will develop quantitative models linking growth and lipid phenotype to fitness, population dynamics and competition, asking when membrane-spanning lipids should be favoured and whether these mechanisms can help explain their occurrence across natural environments.

The student will shape the project by selecting microbial systems, environmental conditions and quantitative approaches according to their interests and emerging results.

The Bristol–Exeter partnership provides complementary training that would be difficult to obtain within either group alone: microbial physiology, culture systems, lipid analysis, and analytical

chemistry at Bristol, alongside mathematical modelling, population dynamics, and microbial ecology/evolution at Exeter. The student will therefore learn to connect mechanistic experiments with quantitative theory and environmental observations, developing a uniquely broad toolkit for understanding microbial responses to environmental change.

Useful recruitment links:

For information relating to the research project please contact the lead Supervisor via: david.naafs@bristol.ac.uk

Bristol NERC GW4+ DTP Prospectus:
https://www.bristol.ac.uk/study/postgraduate/research/great-western-four-doctoral-training-partnership-nerc/

How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/

The application deadline is Thursday 7 January 2027 at 2359 GMT