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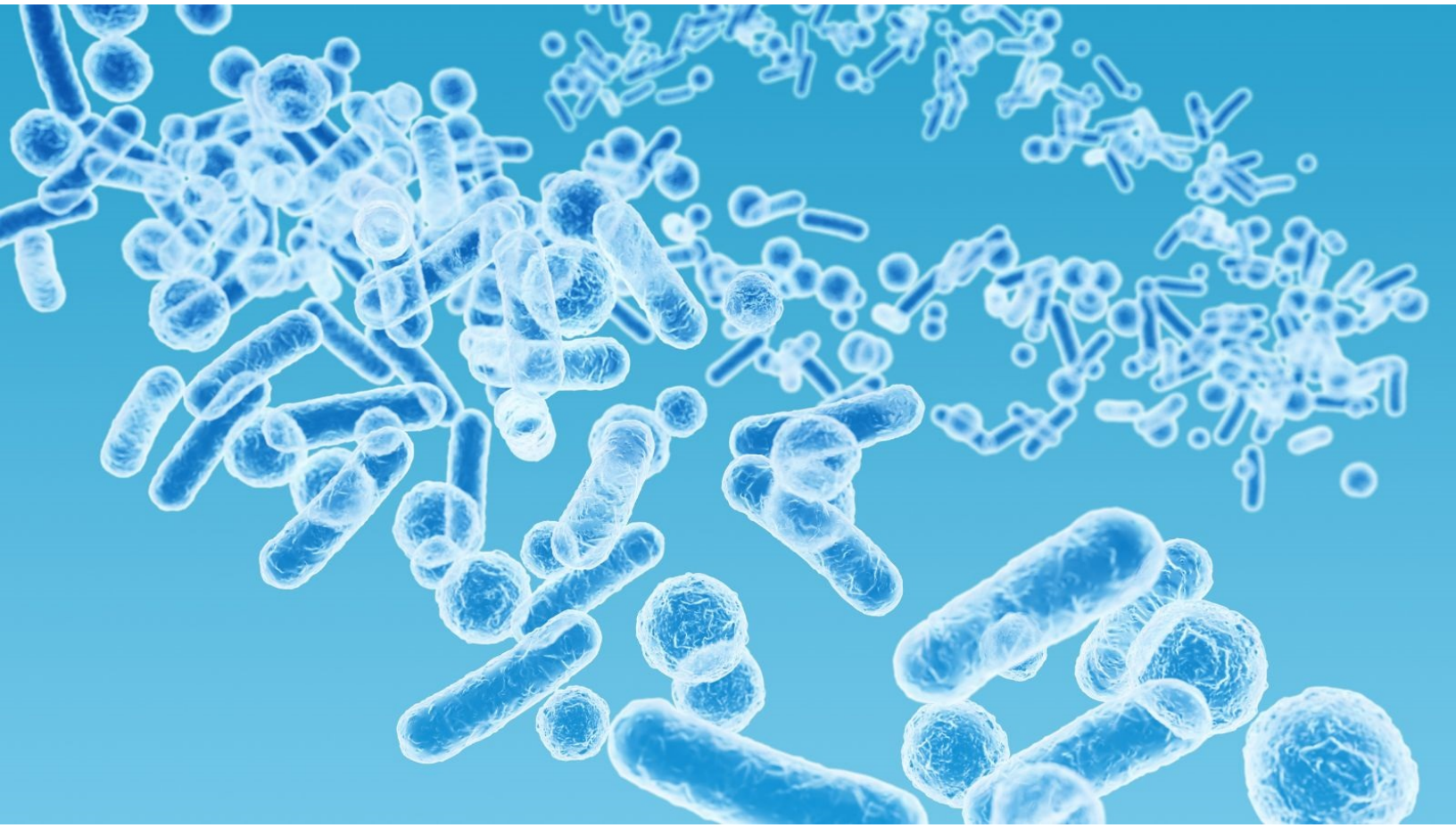

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Research to explore evolutionary mystery of early life on Earth

They are too small to see with the naked eye, but microbes make up the vast majority of life on Earth – found in the soil, water and air around us, as well as inside our bodies.

Tiny, single-cell organisms, precursors to modern bacteria, were the earliest form of life on Earth, estimated to have first appeared around four billion years ago.

And yet despite their prevalence in our lives, there is still a mystery

surrounding early bacterial evolution – specifically, why most bacteria have two membranes surrounding their single cell, whereas the cells in almost all other life forms have just one main membrane.

Scientists are unsure if the first bacteria on Earth had a single membrane and then evolved to develop the second, or if it was the other way round and the double membrane microbes evolved to create cells with a single membrane.

Due to the vast expanse of time which has passed since this evolution occurred, and a lack of fossilised samples as would be found for larger organisms, it has been very difficult to answer this important question in the journey of life on Earth.

But a new research project being carried out by microbiologists from Northumbria University's Department of Applied Sciences could provide new insight into this early evolutionary mystery.

Professor Iain Sutcliffe and Dr Paul James have been awarded a share of £12 million of funding provided by the Biotechnology and Biological Sciences Research Council (BBSRC) to support projects which have the potential to transform our understanding of the rules of life.

The BBSRC's Pioneer Awards aim to draw upon unconventional thinking and approaches, funding new investigations which aim to radically change the way we think about important biological phenomena covering plant, microbial and animal sciences.

Professor Sutcliffe and Dr James' project, entitled *A testable hypothesis for lipoprotein-driven bacterial outer membrane evolution*, will involve attempting to recreate events that may have occurred during early evolution in a laboratory environment in order to discover how microbes developed a double membrane.

Speaking about the research, Professor Sutcliffe said: "When we think about evolution and biology it tends to be in relation to the conservation of large mammals such as elephants and pandas, or the evolution of humans. But most life on Earth is microbial and single cell microbes dominate all the biological processes on our planet. Therefore, understanding how bacteria evolved will fill a gap in our understanding of evolution and how life on

Earth has changed over billions of years."

> Professor Iain Sutcliffe

Professor Sutcliffe's research focuses on understanding the 'envelope' or outer layers of a bacterial cell. He has previously carried out a survey of different bacterial groups, which revealed that the vast majority have two membranes – one likened to the rubber of a balloon (although less prone to popping), then another waxy layer outside of that.

As he explains: "This was an interesting finding and gave us two options to consider – did the first ever cells have two membranes, but then some bacteria lost one during evolution? Or did the first cells only have one membrane and then the bacterial cells with two membranes develop from those? We can test these theories in the laboratory by starting with a bacteria with one membrane and, hopefully, engineering it to develop the outer membrane."

To carry out the research, Professor Sutcliffe and Dr James will attempt to recreate a situation in the laboratory that could mimic what happened billions of years ago on Earth when microbial evolution was taking place.

As Professor Sutcliffe explains: "It is likely that the early world, going back three or four billion years, was a harsh environment. While human body temperature is 37 degrees centigrade, the organism we're using to carry out our modelling grows at 55 degrees centigrade, or even hotter, so we will ensure it remains at that temperature as these may be more like the conditions under which it originally evolved."

Find out more about the BBSRC Pioneer Awards and the other projects to receive a share of the £12 million funding.

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