# Bacteria must make evolutionary size vs. function tradeoffs

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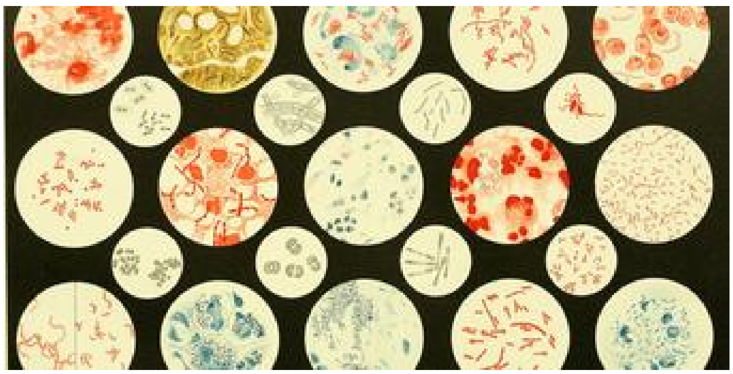

How small can the smallest organism possibly be? Is there a limit to how large an organism can be? These fundamental questions of biology span the fields of evolution, ecology, and astrobiology and are important to understanding how life may have arisen on earth. In a new paper published in the journal of the *International Society for Microbial Ecology*, SFI Omidyar Fellow Chris Kempes and co-authors explore these questions at the microscopic level.

The researchers analyzed the components that made up the cells of bacteria ranging from the smallest to the largest—a range that spanned five orders of magnitude in size—as well as the corresponding physiological functions and metabolisms of these various bacterial species. They discovered that on either end of the size spectrum, space constraints are a limiting factor that prevent the species from condensing or growing further.

The smallest bacteria are dominated by DNA and proteins. The size of these structures means the smallest bacteria are at the lower limit of possible cell size given the requirement for these components. On the other end of the spectrum, the largest bacteria are also constrained by space limitations; any larger and the number of ribosomes they would need to sustain their metabolisms would exceed available cell volume. Between these two extremes, cellular components closely follow trends predicted by biological scaling laws.

"It is important to understand how limitations differ for broad classes of organisms as this informs competitive dynamics and motivates evolutionary trajectories and transitions," write the authors. "We show that the interconnection between energetic, physical, informational (genomic), chemical, and temporal processes leads to predictions of the upper and lower boundaries of bacterial size and defines the evolutionary flexibility for bacteria between these two bounds."

**More information:** Christopher P Kempes et al. Evolutionary tradeoffs in cellular composition across diverse bacteria, *The ISME Journal* (2016). DOI: 10.1038/ismej.2016.21

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