

# Team finds new building block in cells

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(PhysOrg.com) -- Zemer Gitai, an assistant professor of molecular biology at Princeton University, members of his laboratory, and scientists from the California Institute of Technology have published results in *Nature Cell Biology* of new research into how a metabolic enzyme in bacteria forms cytoplasmic filaments that affect bacterial cell shape.

The study was published online July 18.

Gitai describes the findings as follows:

"We have discovered that an enzyme that has a role in basic cellular metabolism (CtpS, the enzyme that makes the essential nucleotide CTP), also forms cytoskeletal filaments that can play a structural role in regulating cell shape.

"I'm very excited about this work since it changes a lot of our thinking about both metabolism and the cytoskeleton, and provides a clue about how the cytoskeleton might have evolved in the first place. The work connects two exciting areas of research: cell shape formation and metabolism.

"Cytoskeletal proteins serve as cellular building blocks, and the [cytoskeleton](#) has long been thought to consist of just three canonical members: actin, tubulin, and intermediate filaments. By using a novel imaging-based screening approach, we found that the [metabolic enzyme](#) that makes CTP, CTP Synthase (CtpS), also plays a previously-

unappreciated role as a cytoskeletal protein by polymerizing into filaments that regulate the cell shape of the curved bacterium *Caulobacter crescentus*.

"The CtpS protein is found in all [living organisms](#) from bacteria to humans, suggesting that this could be a widespread phenomenon. Consistent with this possibility, we found that the CtpS protein from an unrelated [bacterium](#), *E. coli*, also forms cytoskeletal filaments. Excitingly, the *E. coli* protein could replace both the cell shape and metabolic functions of the *Caulobacter* protein.

"This demonstrates that rather than adapting CtpS for a new cell shape role, *Caulobacter* has adapted its cell shape machinery to take advantage of the conserved filament-forming properties of CtpS. This finding suggests a general pathway for how cytoskeletal proteins may have evolved: perhaps polymerization first came about for other non-structural reasons such as enzymatic regulation, and then once filaments were there, they could be co-opted for additional structural purposes."

Other Princeton researchers involved in this work included Michael Ingerson-Mahar, a Princeton graduate student in molecular biology, and John Werner, a postdoctoral research fellow at the University. Caltech authors included Grant Jensen and Ariane Breigel.

**More information:** The metabolic enzyme CTP synthase forms cytoskeletal filaments, *Nature Cell Biology*. [DOI:10.1038/ncb2087](https://doi.org/10.1038/ncb2087)

Provided by Princeton University

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