Research sheds light on what causes cells to divide

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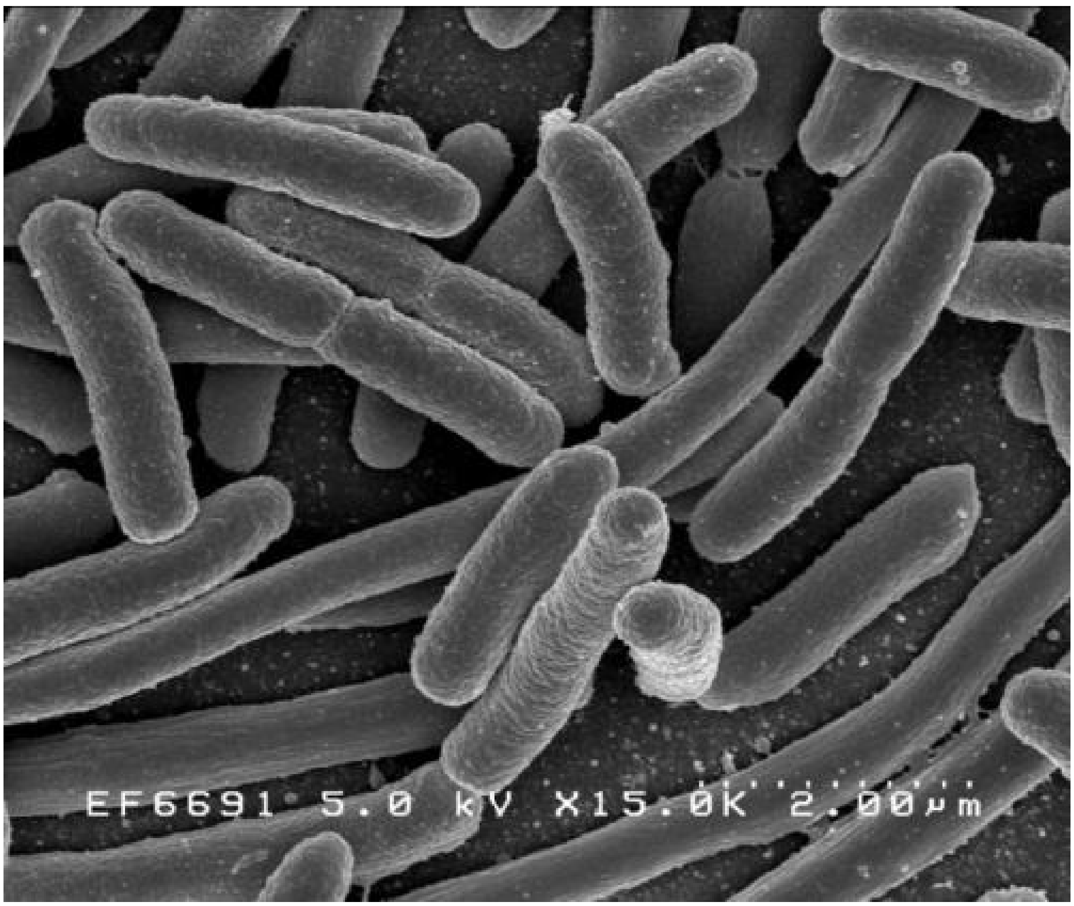

Escherichia coli. Credit: Rocky Mountain Laboratories, NIAID, NIH

When a rapidly-growing cell divides into two smaller cells, what triggers the split? Is it the size the growing cell eventually reaches? Or is the real trigger the time period over which the cell keeps growing ever larger?

A novel study published online today in the journal *Current Biology* has finally provided an answer to this long unsolved conundrum. And it's not what many biologists expected.

"How cells control their size and maintain stable size distributions is one of the most fundamental, unsolved problems in biology," said Suckjoon Jun, an assistant professor of physics and molecular biology at UC San Diego, who headed the research study with Massimo Vergassola, a professor of physics. "Even for the bacterium *E. coli*, arguably the most extensively studied organism to date, no one has been able to answer this question."

Finding a solution was more than a basic-science pursuit for the scientists, who pointed out that learning more about the triggers of cell division would enable researchers to better understand such processes as the runaway cell division that leads to cancer. To conduct the study, Jun and his colleagues developed a tiny device to isolate and physically manipulate individual genetic materials.

"It turned out that we can use this device to also follow the life history of thousands of individual bacterial cells for hundreds of generations," he said. "We looked at the growth patterns of the cells very, very carefully, and realized that there is something really special about the way the cells control their size."

"In our study, we monitored the growth and division of hundreds of thousands of two kinds of bacterial cells, *E. coli* and *B. subtilis*, under a wide range of tightly controlled steady-state growth conditions," said Jun. "This produced statistical samples about three orders of magnitude, or a thousand times better, than those previously available. We could thus pursue an unprecedented level of quantitative analysis."

The scientists found through their development of mathematical models that matched their experimental data that the growth of cells followed the growth law, essentially exponential growth based on a constant rate. But they also found to their surprise that cell size or the time between cell divisions had little to do with when the cells divided. Instead, to keep the distribution of different sized cells within a population constant, the cells followed what the researchers termed "an extraordinarily simple quantitative principle of cell-size control."

"Specifically, we showed that cells sense neither space nor time, but add constant size irrespective of their birth size," said Jun. "This 'adder' principle automatically ensures stability of size distributions."

Provided by University of California - San Diego

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