

# From primordial soup to cells

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Life is complicated. Even the simplest cell has to deal with continual changes in temperature, pressure, food, and anything else the environment wants to throw at it. After millions of years adapting to every kind of condition, it is hard to determine what genes are actually driving the cell and which are only add-ons, like power windows and air-conditioning. Biophysicist Albert Libchaber and colleagues at Rockefeller University have been getting closer over the past few years to identifying what are the bare-minimum components of a cell, and this month they announce new progress.

*Image: Rockefeller scientists trying to identify the bare-minimum*

*components needed for a cell to survive in a stable environment created a vesicle bioreactor (shown above) as a model. Their system may help unlock clues to the origins of life and to how the earliest cells developed.*

Less than a year ago, Libchaber and Vincent Noireaux, a postdoc in his lab, created a vesicle bioreactor, where a phospholipid membrane surrounds an essential-nutrient containing liquid. Into this sphere, they placed a small strand of DNA containing three genes. They showed that this cell-like structure could produce proteins and sustain itself for up to four days as long as the environment remained stable. Since then, Libchaber and Noireaux, along with three other colleagues, have tackled other basic problems that cells have to face every day.

Now, Libchaber, Noireaux and coworkers are tackling other basic problems that cells have to face every day, like waste management. “If you produce, you cannot go on producing forever,” says Libchaber, Detlev W. Bronk Professor and head of the Laboratory of Experimental Condensed Matter Physics. “There must be a balance between production and destruction. But the destruction must be contained so that only specific proteins are degraded.”

The concept of a minimal cell, one that contains only the most essential genes, is being tackled by many different scientists, including Craig Venter, the entrepreneur-biologist who made headlines in the late 1990s for using private funding to sequence the human genome. Using the genome as a base, Venter is trying to reach the same goal as Libchaber by systematically removing genes, eliminating functionality in an effort to attain the bare minimum. This is the approach of a biologist, Libchaber explains. A physicist will take the opposite view – if you understand a system, you can build it from scratch.

Building on their earlier work, Libchaber’s team expanded from three to fifteen genes instructing and controlling their bioreactor. They also are

able to create a sink, where products are removed, in their minimal cells. And they are tackling the basic question of membrane destabilization. When cells divide, the state of the phospholipid membrane that surrounds them must be destabilized so the two cells can split at the very end. Because Libchaber's ultimate goal is to create a minimal cell that can replicate, the problem of membrane destabilization is important.

"Cells are complicated because the outside environment is complicated," says Libchaber. "By creating a minimal cell, in an environment that does not change, it will help us understand the problems posed by enclosure at the origin of life. This paper is an extension towards understanding what a minimal cell requires."

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