Predicting the Population of Self-Assembling Droplets in Cells

The number of distinct droplet types in a cell depends on the cell's molecular components and on how many types of molecules end up in a droplet.

By Christopher Crockett

In cells, proteins and nucleic acids can spontaneously organize themselves into "droplets" that look and behave like the familiar liquid ones. These droplets, which each have their own specific mix of molecular ingredients, appear to be involved in a variety of biological functions. Now, William Jacobs of Princeton University has derived how the maximum number of droplet types depends on the number of molecular components a cell contains [1]. The result hints at the complex armada of droplet types that a cell can marshal in response to external stimuli.

While the initial steps of droplet formation in cells remain unknown, it is assumed that it happens via a nucleation and growth process. Each droplet contains a large number of a few specific molecules, and different types of droplets have distinct concentrations of these molecules.

Credit: W. M. Jacobs [1]

Using a mathematical model in which molecules interact via pairwise interactions, Jacobs shows that the maximum number of droplet types that form in a cell depends on how many different molecule types are available and on how many of those types end up in each droplet. What's more, the number of distinct droplets has faster-than-linear growth with the number of molecule types.

These predictions apply to any system in which pairwise interactions among the units can be programmed, either synthetically or via evolution, Jacobs says. This model may therefore help researchers both understand how cells leverage droplet-making machinery and optimally engineer artificial biomimetic systems using a limited number of components.

Today, *Physics* published another cell story highlighting how molecular stuctures called chromatin may play a role in the formation of droplets that form and grow in cell nuclei (**Synopsis: Chromatin May Control How Droplets Form and Grow in Cells**).

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REFERENCES

1. W. M. Jacobs, "Self-assembly of biomolecular condensates with shared components," Phys. Rev. Lett. 126, 258101 (2021).