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PHYSICS

Experiments Reveal How Cells Can Act Like Molten Glass

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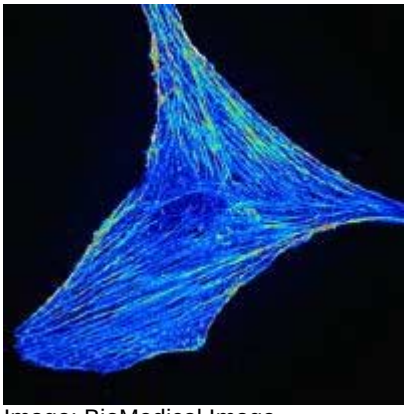

Image: BioMedical Image Laboratory, Harvard School of Public Health

When you think about an individual cell, you no doubt envision a tiny water balloon. In fact, some theories describe cells in just this way: elastic membranes filled with fluids. But a new set of experiments carried out by Ben Fabry, team leader Jeffrey Fredberg and colleagues at the Harvard School of Public Health, Dalhousie University and the University of Barcelona suggest that the behavior of cells is not so simple. They discovered that when smooth muscle cells—a type commonly found in the lungs and bronchi—are deformed, the cells respond like molten glass. Specifically, they gradually become increasingly stiff.

The researchers, who publish their work in the October 1 issue of *Physical Review Letters,* tested the cells by vibrating them at different speeds. To each cell, they attached a magnetic bead, measuring only five micrometers in diameter. When they applied an oscillating magnetic field at varying strengths and frequencies, the bead rolled back and forth over the cell's surface, tugging at the attachment point and jostling the cell around. A video camera recorded the vibrations and a computer algorithm calculated the exact motions of the bead.

Fabry and his team found that, initially, the cells jiggled in response to the moving beads, as predicted by the water balloon model. But as they increased the frequency of the vibrations, the cells slowly grew hard. "This result was most surprising to us," Fabry says, because the water balloon model predicted that instead, the cells would stiffen relatively suddenly and at a characteristic frequency. Much more gradual stiffening, with no characteristic frequency, he says, resembles the way glasses behave. He believes that protein molecules inside the cells act like molten glass particles.

Although it may be too soon to classify cells as glassy materials, Fabry suggests his findings could change the way scientists think about various cell types, including such fibroblasts as the one shown above. The results may also lead to a better understanding of certain diseases—among them asthma and cancer—that involve mechanical changes in the ways cells behave. —*Kristin Leutwyler*

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