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In the Shape of a Fruit, a Blueprint for Robotics

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Xi Chen (Eileen Barroso)

Xi Chen, a 34-year-old mechanical engineer at Columbia, believes he has discovered a way to make medical robots so small they could crawl into your arteries to remove a blockage. His insight came in a supermarket — while he was sizing up a pumpkin.

As Chen inspected the pumpkin’s surface, he was struck by how its ridges were arranged like the teeth of a gear. If he could understand the physical process by which these ridges formed, he thought, he might be able to fabricate microscopic

gears needed as components in the next generation of nanoscale medical devices.

In his laboratory, Chen set up a camera in front of several small, undeveloped pumpkins and programmed the camera to take a photo every day. Weeks later, by analyzing the photos and dissecting pumpkins at various stages of development, he concluded that a pumpkin’s skin grows faster than its inner flesh so that its outer surface buckles. He also quantified — by observing the same process in peppers, melons, gourds, and cantaloupes — how a fruit’s overall shape and the thickness of its skin influence its surface contours.

Since first reporting these findings in 2008, Chen has been making inorganic materials, such as plastic polymers, mimic these natural processes. By coating a micron-sized dollop of gel with a film of polyethylene, and then shrinking the underlying gel, for instance, he can create plastic gears with precisely arranged teeth. He believes that these gears could one day be incorporated into tiny medical devices that enter our bodies to clean out blood vessels or deliver drugs.

“One of the main challenges that engineers now face in trying to develop such devices is creating the gears,” says Chen, who is in conversation with potential industry partners. “They use a chemical process that is time-consuming and very expensive. But by copying nature, we’ve created a method that’s simple and affordable.”



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All categories >