New images reveal how the ear's sensory hairs take shape

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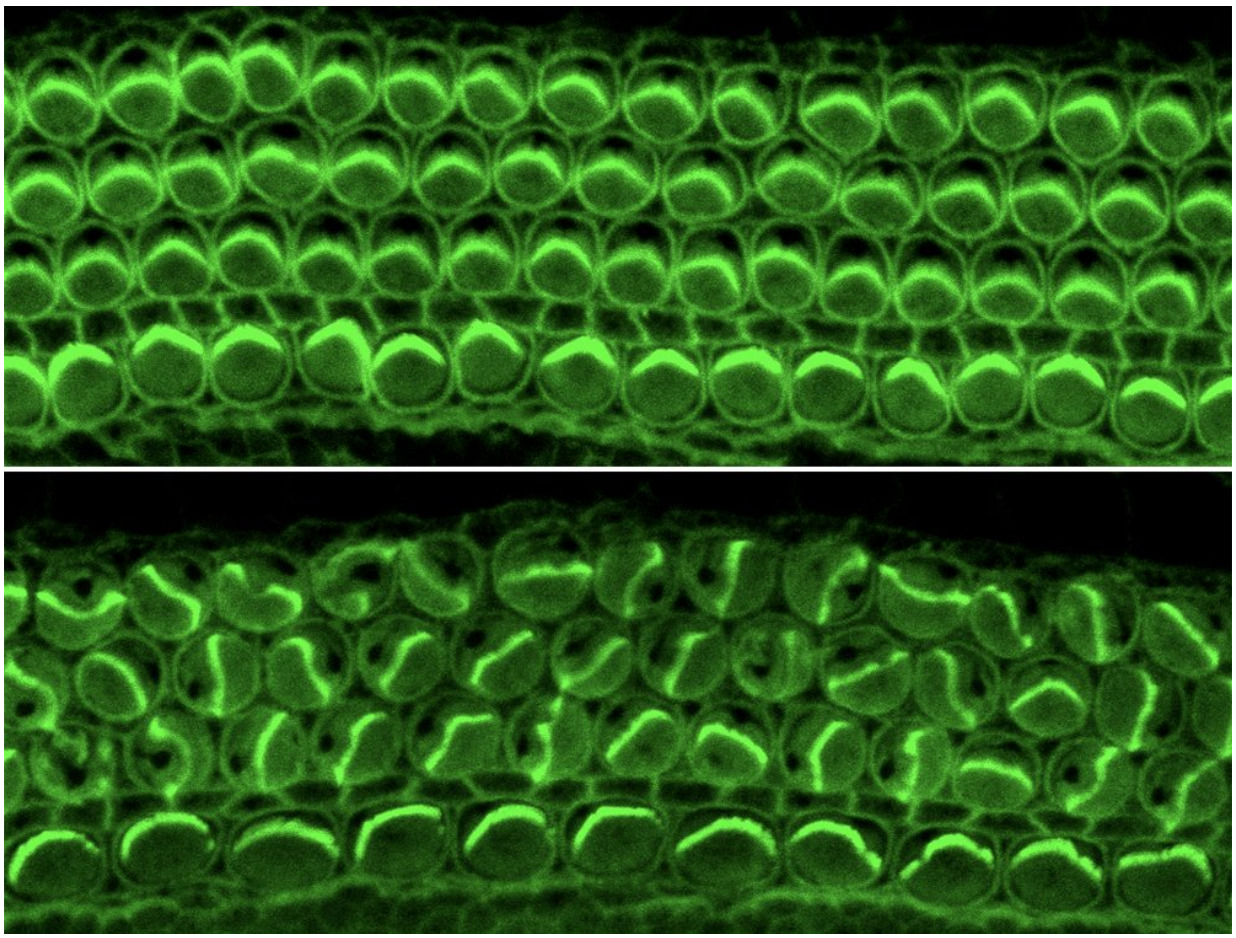

Credit: Rockefeller University

Our ears are exquisite detection instruments, capable of discerning a whisper or distinct notes of music within a symphony. To pick up these sounds, tiny hair-like filaments in the inner ear must be packed into precisely arranged bundles that all face the same direction. The top image above shows the normal, tidy architecture of these bundles on cells within the cochlea, the inner ear structure responsible for hearing.

Researchers in A. James Hudspeth's lab at The Rockefeller University captured the image as part of an effort to understand how the hair bundles are constructed and aligned. Together with a collaborator at The Jackson Laboratory, they have recently identified a molecule that coordinates this process, a discovery that helps explain an important stage in the development of our sense of hearing.

Scientists already knew that a molecular blueprint guides the formation of V-shaped bundles on the surface of inner ear cells that detect sound, motion, and spatial orientation. While investigating how cells draw up these blueprints, Kimberly Siletti, a graduate student in the lab, found evidence implicating a protein called Daple. It was already known to interact with a so-called compass structure, which is formed by a separate system to ensure that the V-shape bundles are aligned properly to catch sound propagating through the cochlea.

If this molecular orientation system is disrupted, the bundles grow facing the wrong direction, sometimes even backward. For the bundle to develop properly, the blueprint and the compass must work together.

"These two systems were discovered independently, and it isn't clear how they are coordinated," Siletti says. "Our experiments suggest that Daple is part of the molecular machinery that links them."

To test this hypothesis, the researchers switched off the protein in mice. The effect of this manipulation, shown in the bottom image above, was conspicuous: the hair cells of animals that lacked the protein developed scrambled bundles without the distinctive V-shape.

The scientists think Daple influences the shape of the hair bundles indirectly, by determining the position of the first filament to emerge at what will become the apex of each bundle. If the filament is positioned improperly, the blueprint gets skewed. Their work was described in the *Proceedings of the National Academy of Sciences*.

More information: Kimberly Siletti et al, Daple coordinates organ-wide and cell-intrinsic polarity to pattern inner-ear hair bundles, *Proceedings of the National Academy of Sciences* (2017). DOI: 10.1073/pnas.1716522115 , dx.doi.org/10.1073/pnas.1716522115

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