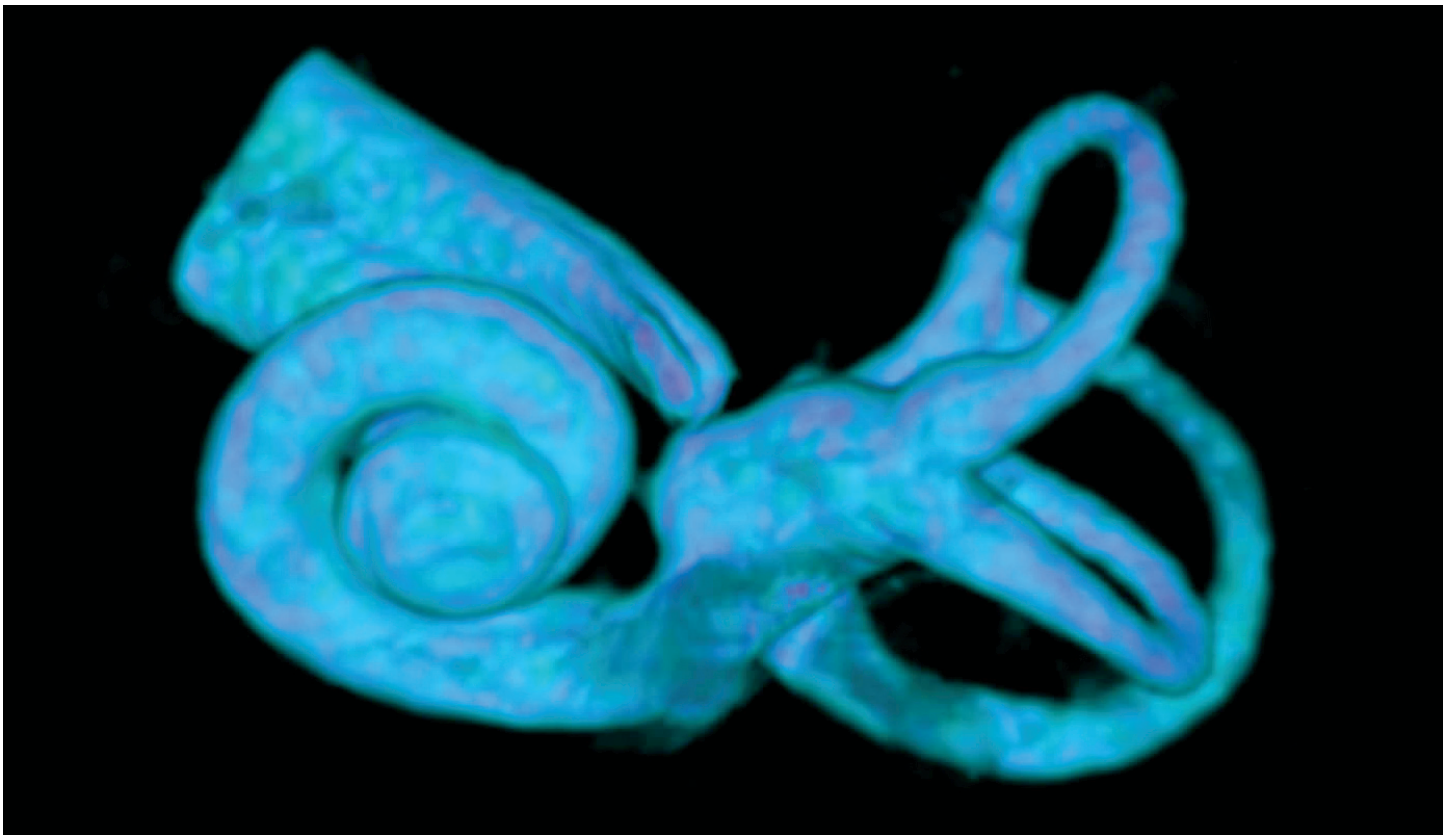

WHOI CSI Facility

Researchers in the WHOI Computerized Scanning and Imaging Facility produced this high-resolution CT scan image of a human cochlea, an organ inside the inner ear, as well as cochlea images from a dozen other different land and marine mammals. Scientists compared the curvature of the cochleas to uncover a secret about why they have spiral shapes.

The spiral secrets of mammals' hearing abilities

Whispering galleries are curious features of circular buildings. As whispers travel along the buildings' curved walls, they remain loud enough to be heard clearly on the other end of even a large room. New research suggests we all carry a couple of them around in our heads.

Inside their inner ears, mammals (but not other animals) have cochleas—coiled shell-like tubes in which incoming sound energy tilts sensory hairs, generating electric signals to the brain. Scientists thought coiled cochleas evolved as a way to pack a longer tube length into the available skull space, giving mammals better low-frequency hearing than other vertebrates, which lack cochleas.

To test the idea, Darlene Ketten, a biologist at Woods Hole Oceanographic Institution (WHOI), and WHOI researcher Julie Arruda provided high-resolution CT scans, taken at the WHOI Computerized Scanning and Imaging Facility, of cochleas from 13 different land and marine mammal species. They included creatures whose hearing abilities are well-documented, ranging from an elephant, mouse, and human to a sea lion and a bottlenose dolphin.

From the CT images, Ketten's group made precise geometric measurements of all the cochleas and sent the images, drawings, and data to a research team led by Daphne Manoussaki, a mathematics professor at Vanderbilt University, and Richard S. Chadwick of the National Institute on Deafness and Other Communication Disorders, who calculated the cochleas' curvatures. They found that the less tightly wound the spiral in an animal's cochlea (or put more mathematically, the broader the ratio of its curvature), the lower the frequency of sounds the animal could hear. The findings suggest that lower curvature improves the focus and penetration of lower-energy, low-frequency sound waves along the inner ear walls, channeling sound more efficiently to the cochlear tips and making sounds more audible—just as in a whispering gallery.

The research, published April 22, 2008, in the *Proceedings of the National Academy of Sciences* as the featured news item, could be extrapolated to improve understanding of hearing (and the impact of human-made noises) in animals whose auditory abilities remain unknown, such as tigers and polar bears, and even extinct mammals, such as land and aquatic ancestors of whales, saber-toothed tigers, and woolly mammoths, whose cochleas are often preserved as fossils.

— Kate Madin

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